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DEVOTED TO TEXTILE WET-PROCESSING

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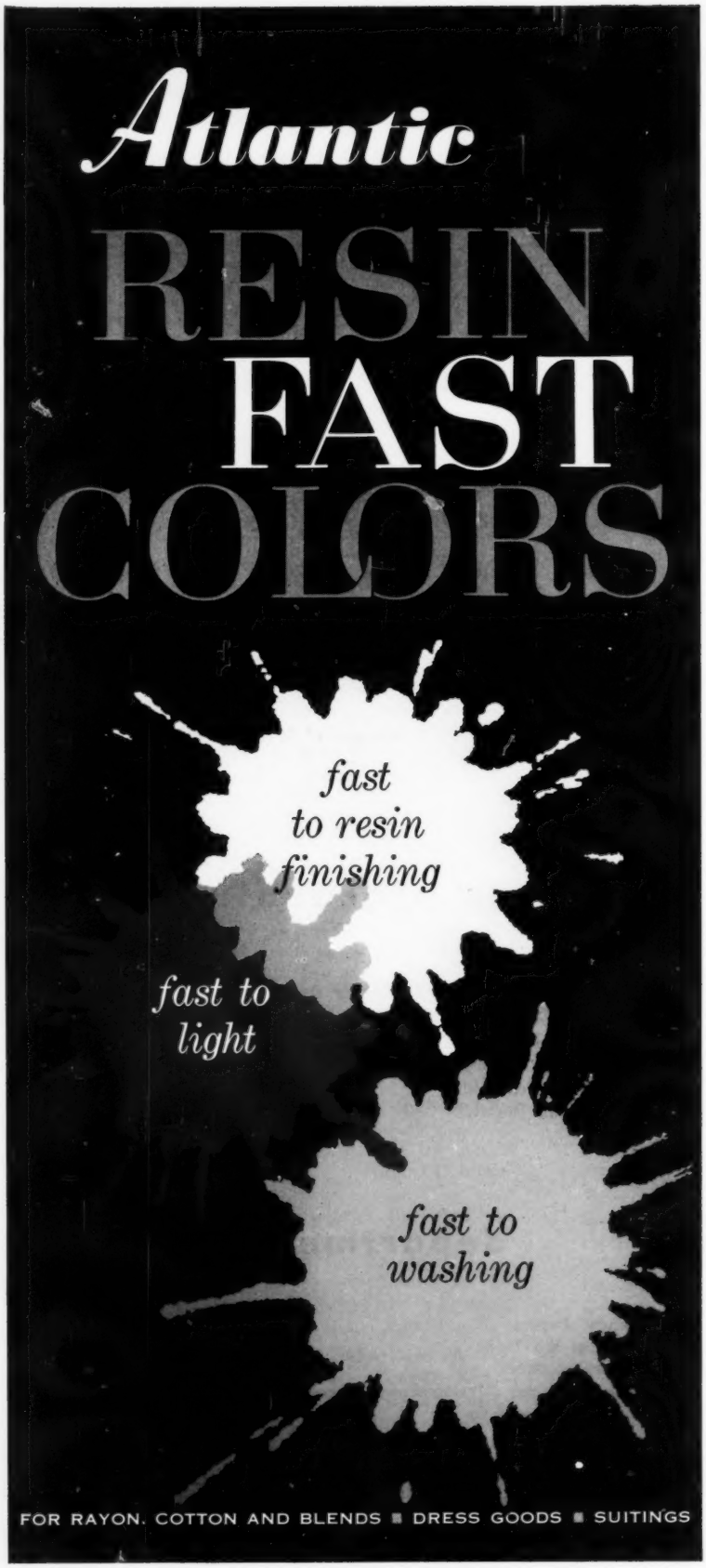

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DYESTUFF REPORTER

Volume 49 August 8, 1960 No. 16

A STUDY OF THE AATCC ACCELEROTOR WHILE OPERATING AT CONSTANT POWER

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Metering the power applied to a fabric sample during a test is presented as an operational method for the Accelerotor. It was found that the weight loss for a fabric sample was directly proportional to the power input to the motor, and that this input power was directly related to shaft output power with a constant efficiency over the useful operating range.

Further findings show a linear decrease in fabric weight with operating time for dry tests with either an abrasive liner or a corrugated rubber liner. An analysis indicates that the inverse of the Accelerotor weight loss at constant power should be related to the fabric wear life for a given end use. Some relationships between constant power operation and constant speed operation were investigated. It was found that the power necessary to maintain speed constant depended in a complex fashion on fabric construction parameters.

INTRODUCTION

VARIOUS operational techniques for the Accelerotor have been presented by Stiegler et al (*1*). Reproducibility of the instrument in interlaboratory comparisons has been reported by Cooke (*2*). The nominal operational methods presented by the above authors are mainly controlled operating speed or controlled starting speed.

A method of operating under controlled power is presented here. By operating where the total energy input to the fabric is controlled, undesirable effects of such parameters as fabric weight and stiffness on the test results are minimized.

EXPERIMENTAL

Measurements were made on an Atlas Electric Devices Co Accelerotor, Type AB7, No. SPA638. In all cases every point plotted was obtained with a new 250 grit abrasive liner. The 4½-inch rotor blade was used in every case. All fabrics were cut 4½ inches square with a ¼-inch ravelled and glued edge except in the case where fabric size was investigated. Before and after each test the sample was drycleaned (carbon tetrachloride solvent) in a hood, then conditioned at 70°F and 65% RH before weighing.

The 2800 rpm speed used in the constant-speed experiments was selected arbitrarily. So also was the 50-watt power input used in the constant power experiments. The speed indicator was checked with a Hewlett-Packard Model 523B counter for precision. It was discovered that the speed could not be maintained to better than ±50 rpm with hand setting and indicator dial observation. No speed indicator errors greater than ±2% were found between 1000 and 5000 rpm when the indicator was supplied with a fresh battery.

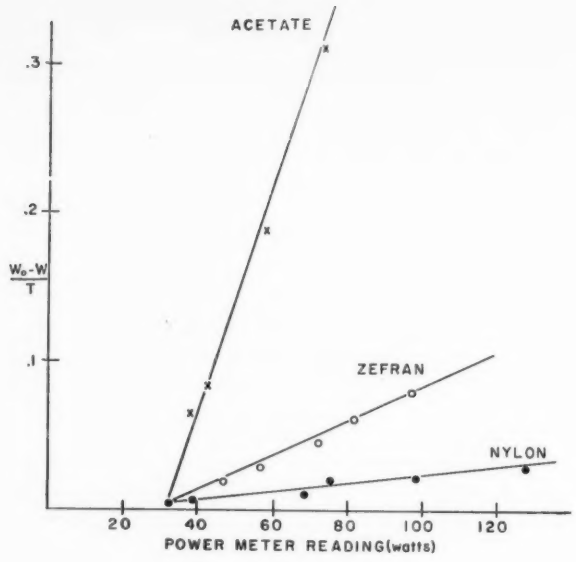
The constant power experiments were performed by connecting a Simpson Model 79 dynamometer-type wattmeter to the Accelerotor. The wattmeter was checked using standard calorimetric methods and found to be accurate to within ± 2 watts at any point on the scale.

Time intervals were measured with an Eagle Cycle Flex five-minute automatic timer. The precision of the timer was established at ±1.5% of the time interval set.

The procedures for constant speed operation are fully described by Cooke (*2*). Constant power operation is equally simple. The proper wattmeter value is selected and maintained constant throughout the desired test period. The validity of this operational method is established by Figure 1, which shows the abrasion rate versus power meter reading for a wide range of fabrics and power levels. The speed range covered by the tests in Figure 1 covered a range from 800 to 5000 rpm. It was expected in the beginning that a correction for air resistance drag on the rotor blade was necessary when operating over this speed range. Applying any such corrections, however, only serves to destroy the linearity of the results.

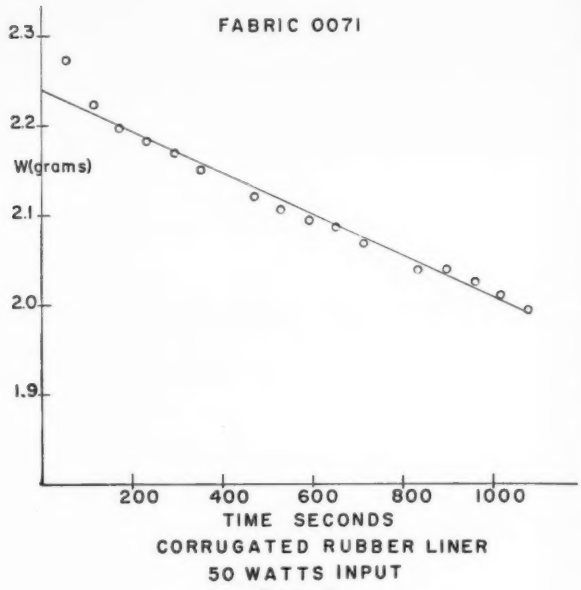
The wattmeter in the above cases was inserted in the line just before the powerstat. In addition to motor losses, there will be a powerstat loss and some power will be consumed by the speed indicator device. These fixed power losses account for the curves intercepting zero weight loss at about 30 watts power input. Under these conditions, the rotor blade would barely turn over at 22 watts without a sample and would barely rotate with a sample at about 30 watts input. This unloaded power to rotate should be checked often because loading of the bearings with fine material occurs after several hours operation and would introduce errors into the results if not compensated for.

A repeat of the experiment with coarse 180 grit abrasive, instead of the 250 grit usually used, produced identical results on the same three fabric samples even to the crossing



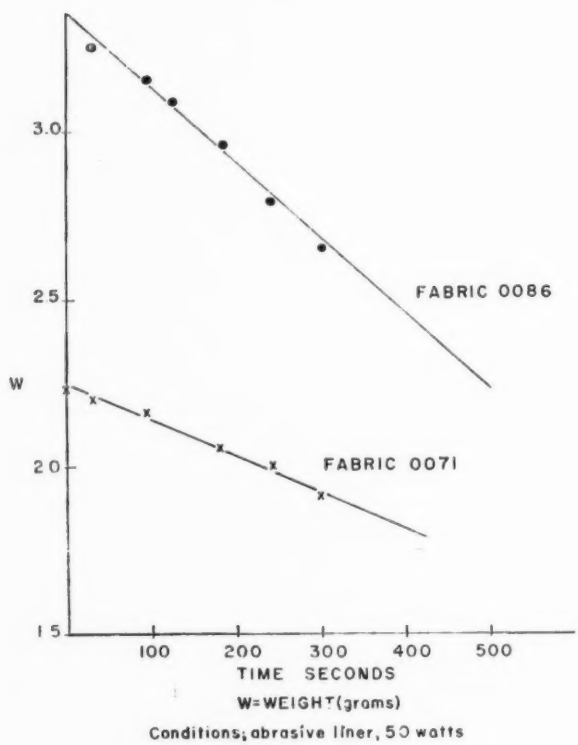
W=FABRIC WEIGHT(grams)
T=TIME(seconds)

Figure 1



CORRUGATED RUBBER LINER
50 WATTS INPUT

Figure 3



W=WEIGHT(grams)
Conditions; abrasive liner, 50 watts

Figure 2

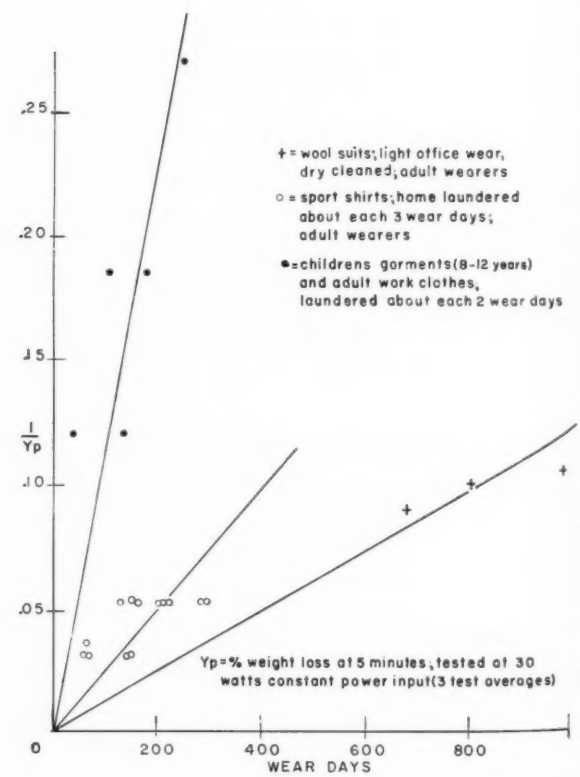

+ = wool suits; light office wear, dry cleaned; adult wearers
○ = sport shirts; home laundered about each 3 wear days; adult wearers
• = childrens garments(8-12 years) and adult work clothes, laundered about each 2 wear days
.25
.20
.15
.10
.05
0
$\frac{1}{Yp}$
200
400
600
800
WEAR DAYS
Yp=% weight loss at 5 minutes; tested at 30 watts constant power input(3 test averages)

Figure 4

of the three lines at $\frac{W_o-W}{T} = 0.004$.

Figure 3 indicates a possible higher than usual initial rate at the beginning of the experiment. Observations on color changes during Accelerotor testing tend to indicate a generally higher than expected initial degradation rate also. These considerations tend to indicate that fabrics usually have some incipient damage present which requires little or no work to develop. Possibly these predamaged fibers are merely shaken out of the test sample during the course of testing.

In order to establish that the results in Figure 1 were not a fortuitous combination of a nonlinear motor efficiency and a nonlinear air drag

operating in opposing directions, measurements of shaft power output versus power input were made. A constant efficiency of 88% was found for the powerstat-motor combination over the entire range covered. It can be noted that constant efficiency can be expected of a well-constructed motor of the series-wound type. If a cheaper motor were substituted, this may not hold. It is noteworthy that the higher power levels cannot be tolerated very long by normal fabrics. Over two minutes at the higher power levels will heat the fabric and glue to such an extent that sticking and softening of the glue will occur.

In all cases henceforth, when constant power input to a fabric is specified, 30 watts are subtracted from the meter reading maintained during the test.

Application of about 50 watts of power to a two- to six-gram fabric sample results in a considerable temperature rise of the fabric in addition to the fiber degradaton produced. This temperature rise can change the basic fiber properties of thermoplastic man-made fibers and in addition, as has been pointed out by Macormac and Richardson (*3*), can cause a rapid change in the moisture regain of hydrophilic fibers.

That the character of frictional and/or abradant surfaces is important and can change with time of operation has been pointed out by Schiefer (*4,5*). Purchased batches of abradant have been reasonably uniform but each successive batch received has differed in some small way from the preceding batch. Corrugated metal liners and corrugated rubber liners can change their frictional properties very rapidly with operational time by either accumulation of finish or by accumulation of the base fiber material. All of the above factors require careful consideration in the accumulation of information on a long-term basis, such as user wear trials of garments.

CONSTANT-POWER OPERATION

The mechanics of weight removal from the fabric in the Accelerotor appears to be a surface action. Stiegler et al (*1*) noted that exposed filling yarns of a certain fabric disappeared first, leaving the more protected warp yarns relatively undamaged. Macormac and Richardson (*3*) present data that shows new fiber ends being produced by the test instrument. In essence, the effective staple length is being reduced and short sections of fiber are lost through attrition. Observations of such mechanisms for fabric wear have been reported by Ecker (*6*) and supporting data from examination of worn garments presented by Clegg (*7,8*).

If it is assumed that the heating and scuffing operations in the Accelerotor as proposed by Stiegler (*1*) remove material from the fabric then,

$$-\frac{dW}{dT}=\alpha\beta$$

where

$\frac{dW}{dT}$ = rate of change of fabric weight

W = fabric weight

T = time

α = a function of all fabric and fiber parameters. It is desired to estimate α with laboratory measurements and by so doing obtain an estimate of the expected average wear life of the fabric in some specified end use.

β = a function of all machine parameters. β could include the properties of the abradant, the rotor blade, the speed, the amount of work done on the fabric, the sample size, the effect of any fabric parameters on interrelations and interactions between machine parameters and so on. It is desired that β either be fixed or measurable.

If all machine parameters are held fixed, and a constant amount of work is metered into the fabric, β should be a constant*. If for any given fabric α is assumed fixed.

Then; $\alpha\beta=K$ where K is a constant

and $$-\frac{dW}{dT}=K$$

hence $W_0-W=KT$

where W_0 = the fabric weight at $T=O$

This indicates that a plot of fabric weight versus time should be a straight line when testing at constant power. Figures 2 and 3 show the results of a test of the above assumptions on three different fabrics of Zefran. Agreement is excellent. In both Figures 2 and 3 the tests were halted as soon as any loss of the glued edge was noted. There is usually a tendency for the lines to turn downward when large losses of the heavy glued edges begin.

Another check on the method was obtained experimentally by comparing the test results on a single and doubled sample of the same fabric. It was assumed that sewing the edges of two pieces of the same fabric together produced a sample of double the weight or thickness with little or no change in such parameters as stiffness and surface character. The results are tabulated in Table I, section A. $(W_o - W)/T$ is reasonably constant for the experiment as would be expected if α and β were both held constant.

If fabric wear in use is considered an equivalent surface phenomena, where loss from the fabric surface eventually results in a hole, then it might be considered that the fabric weight or thickness should be proportional to its wear life. Fabric wear life should also be inversely related to "K" in $W_o - W = KT$. A fabric with a large "K" would lose material at least in the Accelerotor at a much more rapid rate than a faric with a small "K".

Let wear life = Y and C = a constant

then $$Y=C\,W_o/K=\frac{C\,W_oT}{W_o-W}=\frac{100C\,T}{Y_p}$$

where Y_p = % wt loss at constant power.

If comparisons are made at fixed Accelerotor operating conditions and at a fixed operating time

then $$Y=A/Y_p$$

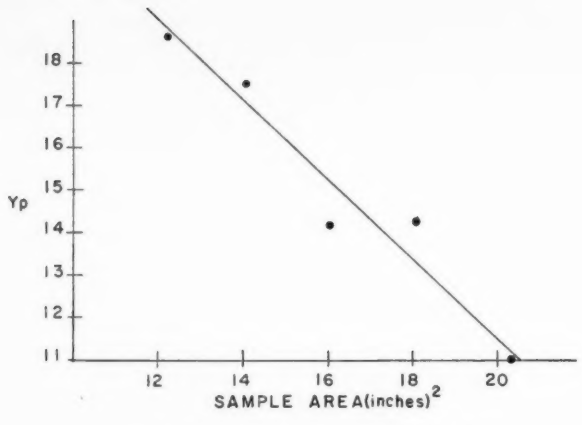
"A" is a constant relating specific Accelerotor operating conditions to a certain end-use wear rate. It would not be expected that all types of fabric end-use wear would produce fabric degradation at the same rate. Fabrics which are drycleaned should have different wear rates than fabrics which are subjected to washmachine action after each wear period. Sport clothes should differ from office clothes and both would be expected to differ from work clothes in their wear rate. Any two individuals would be expected to have different wear rates depending on their weight and activity.

However, the preceding difficulties are minor compared with the difficulties encountered in attempting to obtain reliable end-point data on worn fabrics. There are usually so many other causes for fabric failure that few fabrics survive to be worn out through abrasion in some specific end use. On genuinely good fabrics the wearers tire of the same clothing before it is worn out, or the dyes fail, or some other reason causes discard before a genuine end point is reached.

Figure 4 shows the reciprocal of weight loss at constant power plotted against the wear days for the few fabrics which reached genuine end points in our wear trials. The fabrics plotted are dresses, sport shirts and trousers. The fibers were Zefran, wool, rayon, and blends of Zefran with rayon.

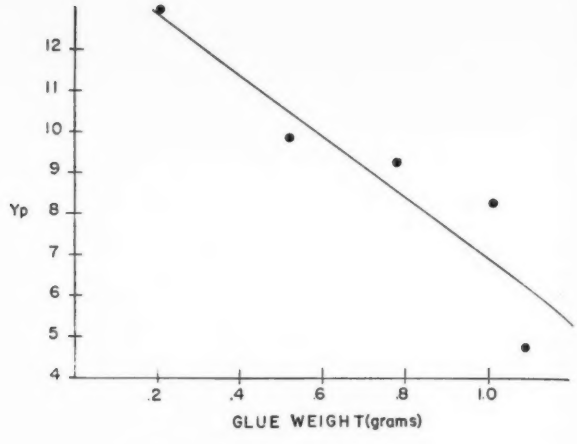
Each point plotted in Figure 4 is

*Strictly speaking, most of the energy input to the fabric goes into heat production. For correlation purposes it is necessary to assume that the same proportion of energy input is absorbed by the fabric as damage-producing work as one examines different fabric types and fiber types. An example where this may not be true is where fibers of widely differing regains are encountered. Energy will be absorbed in driving off moisture and as a consequence the temperature rise will not be as great in the fiber with the higher regain. If the effect of the Accelerotor on the fiber differs with temperature, then the two different fibers would have been compared under different operating conditions.



Yp = % weight loss at 50 watts constant power

Figure 5



Yp = % weight loss at 50 watts constant power

Figure 6

the result to a hole through the fabric of an individual wear test on some garment. The eight clear circles plotted at $1/Y_p = 0.052$ are all garments made from the same fabric but worn by different wearers. The four clear circles at $1/Y_p = 0.030$ are also the results of different wearers wearing equivalent garments from the same fabric sample. Estimates of the variability among wearers give coefficients of variation from 28% upward. There was a general tendency with one exception for the older and heavier wearers to have lower rates than younger, lighter, and generally more active wearers.

Young children eight to twelve years, and work clothing wear results were classed together. This may not be exact, but at least both cases have a much higher wear rate than sport shirt wear. There are at least five garments equivalent to those worn out by the youngsters and of the same fabric which show no signs of wear at two and one half to three times the wear life plotted. These other fabrics are being worn by adults in a sport-shirt application.

Mens suiting is either a very gentle wear application or perhaps drycleaning in place of laundering is less destructive. In any event, there is quite a large difference in the expected life of a garment in this application as contrasted to the work clothing and laundered sport shirts.

An experimenter has several choices in collecting data equivalent to those shown in Figure 4. In one case, more severe test conditions could be applied to test samples in direct proportion to the severity of the intended end use. This would in effect normalize the results in terms of wear time. Alternately each end use could be maintained separately as was done in Figure 4. Either of the above alternatives, however, requires much more extensive results before such differences can be established with certainty. The reliability or certainty of the few wear test results presented do not allow much more than an estimate due to the wide scatter between individual wear testers and their environments.

The effect of sample area on the abrasion rate at constant power is illustrated in Figure 5 and the pertinent data tabulated in Table II. The glued-edge area was subtracted from the abraded area on the assumption that very little glue loss occurs in normal tests of less than six minutes duration. This is a matter for observation on most fabrics because some very weak fabrics would lose parts of the glued edge sooner. Indications are that size of sample is a matter for strict control. A 5% error in the cut sample area would give an equivalent change in the results, as indicated in Figure 5.

Figure 6 illustrates the effect of more or less glue applied to the sample. Nominal glue weights range from 0.2 to 0.35 grams depending on fabric thickness. The samples outside this range were prepared by applying successive coats of glue and allowing the samples to dry overnight. Estimating from Figure 6, control of the glue quantity is also a matter for concern. The apparent magnitude of the effect is about a ± 8% change in Y_p over the nominal glue range.

Figure 7 illustrates the principal reason that all tests should be performed with a new abrasive liner. There is nearly a 2:1 change in the results from the fifth to the 50th min-

TABLE I

SECTION A

	W_o	W_s	$\frac{W_o-W_s}{5}$	P	S	y_p
single fabric section	1.48	1.30	.036	70	3200	12.1
doubled fabric section	3.35	3.18	.034	70	2100	5.1

SECTION B

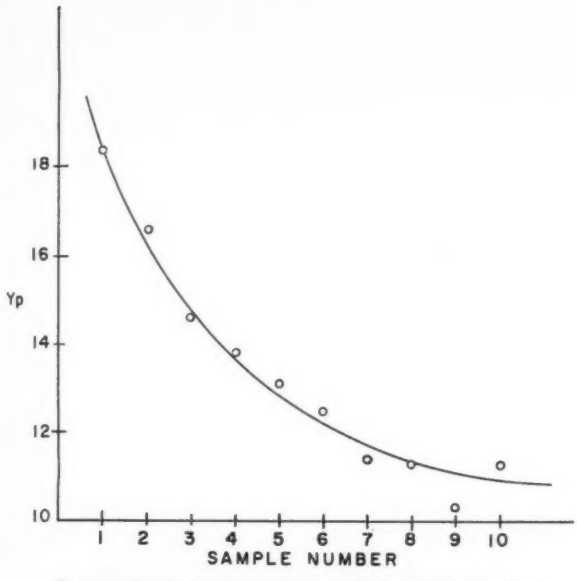
	W_o	W_s	$\frac{W_o-W_s}{5}$	P	S	y_s
single fabric section	1.50	1.35	.030	48	3000	10.0
doubled fabric section	3.12	2.81	.062	102	3000	10.0

W_o=initial sample weight in grams
W_s=weight after five minutes operation with abrasive liner, grams
P=power input to the fabric, watts
S=operating speed in RPM
y_p=% wt loss at constant power
y_s=% wt loss at constant speed
$\frac{W_o-Wt}{t}$ =weight loss per unit of time $\frac{\text{grams}}{\text{minute}}$

TABLE II

Fabric	Size (in)	Abraded area $(ins)^2$	W_o	W_s	$\frac{W_o-W_s}{5}$	y_p
0086	4	12.25	2.64	2.15	.098	18.6
0086	4¼	14.06	2.88	2.38	.101	17.5
0086	4½	16.00	3.45	2.96	.097	14.1
0086	4¾	18.06	3.63	3.12	.103	14.2
0086	5	20.25	4.11	3.66	.091	11.0

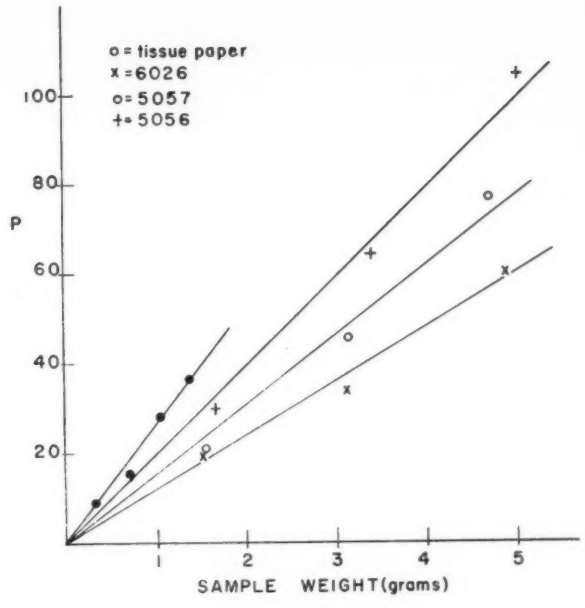
Fabric	Wt without glue	Glue wt	W_o	W_s	$\frac{W_o-W_s}{5}$	y_p
0071	2.05	.21	2.26	1.97	.058	12.9
0071	2.01	.52	2.54	2.28	.051	9.8
0071	1.95	.78	2.73	2.98	.050	9.2
0071	2.06	1.09	2.16	3.00	.030	4.7
0071	2.00	1.01	3.01	2.77	.049	8.2



Successive tests, new sample of same fabric, same abrasive liner

Yp = % weight loss at 50 watts

Figure 7



P = power in watts

Figure 8

ute of operation. All pertinent information concerning Figures 5, 6, and 7 is tabulated in Tables II and III.

CONSTANT-SPEED OPERATION

Some attempts to establish working relationships between constant-speed operation and constant-power operation indicated that a great deal must be known about the properties of the fabric in order to predict the results of one method from the results of the other.

Starting with the same relationship

$$-\frac{dW}{dT}=\alpha\beta,$$

the effect of some fabric parameters on the power input necessary to maintain constant speed was investigated. Three fabrics with as wide a range of properties as was convenient were selected and a soft flexible tissue paper was added to obtain another extreme. The effect of increasing the fabric (or paper) thickness was investigated first. Single, doubled, tripled and quadrupled sections were fastened together and power input to the fabric was measured at 2800 rpm. Figure 8 illustrates that, for any given fabric, the consumption of power is reasonably linear when related to fabric weight. Just as obvious, however, is the point that each of these widely different fabric types is a different case.

Table IV lists the pertinent values of stiffness, stress-strain data, and fabric-to-abradant frictional coefficients for the fabrics illustrated in Figure 8. All of the factors appear highly correlatable each in its own right but the information is insufficient for serious study.

Of interest is the following analysis of constant-speed operation:

Assume that α is constant for a given fabric and that from Figure 1 and Figure 8 $\beta = K_1 W$

then $$-\frac{dW}{dT}=\alpha K_1 W$$

and $$\frac{dW}{W}=-\alpha K_1 dT$$

hence $$\ln\frac{W_o}{W}=\alpha K_1 T \quad \text{if } W=W_o \text{ at } T=0$$

further

$$e^{\alpha K_1 T}=\frac{W_o}{W}=1+\alpha K_1 T+\frac{(\alpha K_1 T)^2}{2!}+\ldots.$$

For most fabrics observed $\alpha K_1 T$ is less than 0.3. Neglecting second or higher order terms will not result in serious errors,

hence $$\frac{W_o}{W}-1\simeq\alpha K_1 T$$

then $$\frac{W_o}{W}\,Y_s\simeq\alpha K_1 T$$

and

$$Y_s\simeq\frac{\alpha K_1 T}{e^{\alpha K_1 T}} \text{ where } Y_s = \%\text{ wt loss at constant speed}$$

Hence, at fixed operating conditions for a given fabric, the % weight loss at constant speed is independent of the initial fabric weight. The data illustrated in Table I, Section B, at constant speed bear out this point. A single fabric section gave an identical % weight loss to a doubled section of the same fabric.

Attempts to plot $\ln\frac{W_o}{W}$ vs Accelerotor time at constant speed and obtain the type of linearity observed

TABLE III

Sequential tests, same fabric, same abrasive liner

Test no.	W_o	W_s	$\frac{W_o-W_s}{5}$	Y_p
1	3.29	2.68	.121	18.4
2	3.35	2.79	.111	16.6
3	3.35	2.86	.098	14.6
4	3.41	2.94	.094	13.8
5	3.34	2.90	.087	13.1
6	3.31	2.89	.083	12.5
7	3.35	2.97	.076	11.4
8	3.32	2.94	.075	11.3
9	3.35	3.01	.069	10.3
10	3.17	2.81	.071	11.3

TABLE IV

Fabric	*A*	*E*	*S*	*W*
Tissue Paper	2.88	8.85	11.2	.640
No. 6026	1.22	7.18	29.6	.800
No. 5057	.62	2.05	33.8	.780
No. 5056	1.10	4.48	82.0	.780

A = area under stress-strain curve to 500-gram load, two-inch jaw separation, 45° bias to warp and filling, one-inch jaws, Instron tensile tester, in square inches.
E = extension to 500-gram load, above conditions, in % extension of initial gauge
S = cantilever stiffness (ASTM D1388-57T) in gm-cm
W = fabric to abradant frictional coefficient

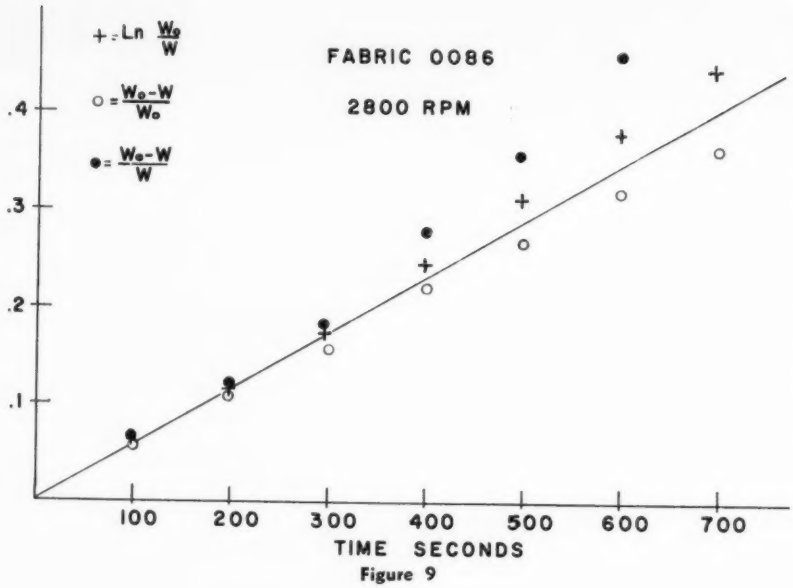


Figure 9

with the constant power method were not successful. Neither the % weight loss or the logarithm of the weight ratios produced precise data.

Typical results are shown in Figure 9, where

$$\ln \frac{W_o}{W}, \frac{W_o - W}{W_o} \text{ and } \frac{W_o - W}{W}$$

are plotted versus Accelerotor time at 2800 rpm. It is highly probable that the properties of the fabric are changing during the test and are responsible for the different power consumption versus weight levels as shown in Figure 8. Hence the assumption that aK_1 is fixed during the test may not hold. It was not possible to carry a fabric through to establish the validity of either

$$\ln \frac{W}{W'}, \frac{W_o - W}{W_o}, \text{ or } \frac{W_o - W}{W}$$

a sufficiently prolonged experiment versus time. All three appear to depart from linearity. Neither of the three formulas presented above would be distinguishable from each other or a straight line at short time intervals.

CONCLUSION

Metering the amount of power applied to a fabric test sample has considerable merit as an additional operational method for the Accelerotor. Complex fabric parameter effects are minimized or eliminated from the test results. As a consequence the interpretation of the results is made much simpler. The method should allow comparison of a wider range of fabric weights and styles without changes in the nature of the abradant or other machine parameters.

For purposes of comparisons between treatments on the same fabric, the constant-speed method should be quite valuable since it was shown that results should be independent of any fluctuations in the sample weight.

It is felt that the constant-power method of fabric abrasion testing allows a fundamental evaluation of an intrinsic property of fabrics. Whether the Accelerotor is the proper instrument for performing laboratory abrasion test on fabric samples only time will tell. Certainly, the constant power method should help eliminate machine parameter, fabric parameter interactions.

All that really remains to be proven is the relationship between fabric failure in wear and the amount of energy expended on the fabric in any given end use. If this is fixed, then the method should be of extreme value.

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1959 Intersectional Contest———

FLUORESCENT BRIGHTENERS AND BLUING AGENTS IN WOOL PROCESSING*

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Fluorescent brighteners and blue dyes are often used to adjust the off-white yellow color of wool to a more pleasing white desired for sales purposes. The dyes actually used for this have been determined by survey, and found by test to have generally poor wetfastness, poor lightfastness, or both. These are seldom applied with uniformity, may cause drift of shade in subsequent continuous scouring, and may lead to difficulty in precise matching of very light shades. The fluorescent whites are particularly troublesome even in the skein dyeing of light to medium shades, and they migrate to some synthetic fibers in union dyeing. To what extent and in what way these agents contribute to processing difficulties are drawn from mill experience and are shown in laboratory dyeings, fastness tests, etc.

Difficulties in simple methods of detection of small amounts of these materials are discussed.

INTRODUCTION

THE off-white color of undyed wool raw stock and top is often altered by the application of bluing and whitening agents. However, as such agents may occasion difficulties in subsequent processing, some processors of wool in these forms have specified against bluing and whitening agents or both on lots intended for their use. Oddly enough, available methods of testing for the presence of such materials are not always reliable, and the exact nature of the difficulties attributed to these agents has not been elucidated completely.

Thus it was considered useful to study technically the application of bluing and whitening agents, their possible effects on subsequent wet processing and the adequacy of common test methods.

DISCUSSION

WOOL COLOR———Primarily, the off-white coloration of wool occurs naturally, ie, it exists in the wool or arises from matter present in the fleece of the sheep. The deep color of fibers pigmented (*1*) with melamin (*2*) or melanoprotein (*3*) growing on certain kinds of sheep are certainly natural, but more than just off-white. More nearly off-white is the color of the tips, the stained ends and bright canary which arise from hereditary or environmental factors. These colors are relatively permanent, the more pronounced being only slightly affected by usual commercial levels of treatment in continuous processing for improvement of the color of raw stock and top. The effect of a few tips, though obvious in the stock form, is relatively less important as these may break off in carding and subsequent processing and are less apparent in the blended fibers. The off-white color of the root ends of most wools, the general color of rather uniform good color wools such as fine Cape, Australian, Bahia Blanca, some Wyoming, Oregon and Texas, and sorts of unstained pulled wool is very light and truly only off-white. This off-white color which has been attributed to disulfide bonds acting as chromophores (*4*), is the usual object of continuous color-adjusting treatments applied to wool raw stock.

Stubborn discoloration of wool may also occur in prolonged storage because of bacterial action (*5*), which accelerates at higher temperature and moisture content, and because of the action of yolk, suint and grease on the wool, particularly in some domestic wools and supposedly most often in wools from sheep penned with other livestock (*6*). As pointed out in a USDA survey (*6*), processors rely to some extent on color as a criterion of the care of sheep and fleece, poor color being associated with fiber weakness, poorer spinning quality and harsher feel for wools of similar origin.

Quite fugitive is the color of fadeable dirt. In scoured-only wools (*7*), this coloration originating from the vegetable matter or tags accumulated in the fleece (*8*) is readily lessened by scouring, stripped by reducing agents, and faded by light.

Some trace of color also is almost always contributed by the residual adsorbed soil, whether dirt or grease, which it is never practical to remove completely in commerical raw-wool scouring. This is particularly apparent in certain California wools.

Secondarily, both in sequence and degree, discoloration can be introduced in processsing (*7, 9*). Ordinarily, discoloration in processing is negligible. However, for the sake of completeness, some possibilities should be mentioned. Alkali damage to wool leads to a yellow discoloration. De-

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spite the almost universal adoption of nonionic detergents for scouring, scouring baths are not always neutral, due to the absorbed alkali and adhering alkaline depilatory of pulled wools, and due to alkaline suint or soil of some shorn wools, as for example some Territory and New Zealand. In drying, some discoloration may occur if temperature or pH is too high. In carbonizing and neutralizing, discoloration may be more appreciable. Less frequent would be contamination with metals as from rusty water supply, or from corrosion of equipment, particularly in neutralizing or muriatic acid carbonizing. Pigments redeposited from sheep-marking fluids can contribute. In particular circumstances, algae in the water supply has given trouble (*8*). Wool oils for carding, combing and spinning sometimes impart considerable coloration (*10*). Oils may be found on some raw stock and on American dry-combed top and noil.

ALTERATION OF COLOR——— The methods of altering the color of wool raw stock and top fall into two categories, viz, removal and masking.

Removal of adsorbed coloring matter may be accomplished by scouring. Discoloration due to residual natural soil, dirt or grease, scourable branding fluids, added oil and to some extent fadeable dirt may be removed this way.

Ordinarily such matter constitutes a very minor source of color. Physical removal of extraneous matter leaves the stock better suited for obtaining optimum dyeing results, and if accomplished without fiber damage, the stock may show somewhat improved processing characteristics in some instances. Absolutely complete removal of coloring matter is not practical, but reduction to a negligible level is. As such matter is normally expected to be removed in the usual cleaning processes before finishing the final goods and as a similar coloration may develop with soiling in use, coloration removable by scouring may be termed temporary coloring matter.

For removal of coloring matter more inherent in the wool, bleaching with hydrogen peroxide is ordinarily used. The natural off-white color of wool, tips, stained ends, canary and even deep pigmentation may be permanently bleached with hydrogen peroxide (*10, 11*).

In the acid dry-in-process (*12*), a continuous process, hydrogen peroxide is maintained in the last bowl of a scouring train or backwasher together with enough acid (usually sulfuric) to bring the wool to the desired neutral or slightly acid pH. The effect is an overall increase in brightness (*7,13*), particularly apparent in the very near-white uniform wools or near-white root ends of stained or tippy wools. Also, bleached wool dyes more uniformly, apparently because of the increased rate of dye pickup in the root end. If stored long enough or if treated with a reducing agent to destroy residual peroxides, the wool may be dyed to considerably brighter shades (*12*). Some improvement in raising properties for fabrics (*14*) and in fulling properties may also occur (*15*).

In steeping processes, usually batch processes (*11, 13*), hydrogen peroxide is applied in liquors made alkaline with ammonia and stabilized with phosphates, sometimes in conjunction with organic chelating agents. The improvement in brightness obtainable is much greater than with the dry-in method, the color of tips, stained ends and canary yielding to the alkaline steep processes.

The ferrous mordant process (*16, 17*) effectively bleaches pigmented wools.

The reduction of wool color by chemical means is also possible by sulfur dioxide stoving (*9*). Stoving may be applied to improve the color and bloom of wool bleached with hydrogen peroxide. Stoving by itself, however, was seldom applied to raw stock and has pretty well fallen into disuse in favor of hydrogen-peroxide bleaching, the destruction of color by sulfur dioxide being reversible.

The reduction of color by using sodium hydrosulfite in the second last bowl or by stripping with sulfoxylates has been suggested by chemical suppliers, but the Committee is unaware of any commercial application in the preparation of processed raw wool and top.

In all instances of chemical treatment to remove color, the wool becomes harshened to the hand, chemical damage is readily detected in the increase of alkali solubility, and in the alkaline steeping processes, some loss of weight can be detected (*6*), the extent of each depending on the intensity of treatment. A USDA survey (*6*) shows most processors objecting to strong bleaches but tolerating mild bleaches for all uses except knitting yarns and felts.

As a masking treatment, the acidification of wool raw stock with sulfuric acid has found some use. With sufficient sulfuric acid applied in the finishing bowl, wool appears obviously whiter. The coloring matter of the wool is not really destroyed and reappears upon neutralization. However, at pH near or below the isoelectric point to about as low as pH 3, wool is less sensitive to damage (*18*) and discoloration by heat as in drying, and some ultimate advantage may be had if severe drying conditions are to be compensated for.

Masking of natural and induced discoloration may be accomplished by increasing the reflectance of the wool without removing the coloring matter. Some metallic salts, particularly titanium, tin, zirconium, magnesium and aluminum salts, have been applied in the last bowl of the scouring train. However, since the wool sometimes becomes almost water repellent and some dyes are affected by the residual salts, such treatments fell into disrepute and were abandoned.

The apparent visible reflectance of the wool may be increased by a fluorescent brightner, which absorbs incident ultraviolet or near ultraviolet and emits some of the absorbed energy as visible light (*19*). Thus the effect varies with illumination. Brilliant results are obtainable through these agents if the illuminant contains sufficient ultraviolet.

With the possible exception of brighteners with purest blue fluorescence on nearly white wools, all these treatments still leave the wool color somewhat off-white to the yellow. Thus tints or bluing agents are applied to bring the shade toward the blue, preferably without running into the blue. The eye judges the sample whiter even though the reflectance is lower because the eye is more sensitive to hue than depth. The color, relatively, is hardly affected by ordinary changes in illumination and blue dyes are often used with fluorescent brighteners to minimize the dependence of shade on illumination. With blue alone, only very light coloration may be masked in this way. Increasing yellowness cannot be masked completely without producing perceptible greyness (*10*), and in uneven wools, without an obvious blue tint on white portions. The response of wool color to bluing then is a function of its original whiteness.

The relative effect of the more common adjustments of wool color in continuous processing was illustrated in samples prepared for the purpose.

Medium New Zealand slipe was finished 1) with no color adjustment, 2) with CI Basic Violet 1 and CI Basic Blue 9 applied in the rinse bowl preceding the last bowl at near the maximum practical amount, 3) with 4-methyl-7-diethylamino coumarin in the last bowl at a concentration to give the maximum amount of fluorescence encountered commercially, and 4) with both of the latter treatments. An additional set of four samples was prepared for which 2.5 vol hydrogen peroxide was included in the last bowl. In each case the last bowl was at 115°F and contained enough sulfuric acid to bring the pH of the finished wool to from 6 to 7. The immersion time was 2.5 minutes. Samples were dried at 140°F to near condition.

It was noted from the fluorescence curves obtained using a Cary Fluoresence Spectrometer that bleached samples showed a trace more fluorescence than did unbleached samples without brightener, and much (over 40%) more fluorescence in the case of brightened samples.

Quantitative expression of these color differences in perceptible units from location in ICI color space might seem desirable. Unfortunately, the complications (*21*) of forming an energy curve from the reflected and emitted spectra determined on different instruments to represent the curve produced by daylight became more involved than time or the samples warranted. Illustrations of the effect of bluing and bleaching on the reflected energy distribution (*7*) and of bluing and fluorescent brightening on location in color space (*21*) have been published. Since the eye, although less precise than some instruments in rating fluorescence, is most accurate (*21*), and since the eye is the ultimate standard of color, these samples were displayed for visual inspection by eight nonscourers. Their agreement in rating these typical samples verifies the impression of wool scourers that bluing produces as much alteration in the immediately apparent color of wool raw stock as ordinary levels of hydrogen peroxide dry-in bleaching alone. Under artificial lights, the effect on color produced in these samples by bluing alone was at least the same magnitude as produced by fluorescent brightening but was not quite as white because of difference in brightness.

For order of whiteness, the samples were ranked visually under a variety of illuminations. The results are listed in Table I, where the whitest sample is given the lowest number and where particularly difficult distinctions are connected by dotted lines. Simple bleaching ranked below simple bluing in all lights except for a near tie in north light through glass, this distinction being more apparent under artificial and natural twilight. Under artificial lights, bluing with bleaching exhibits better whiteness than brightener alone, but in light with more ultraviolet, the relation is unmistakably reversed. In sunlight and daylight, the off-white yellow was completely masked in the samples with blue and brightener.

TABLE I

Whiteness rank of typical samples in various illuminants

ADDITIVES

	None		Blue		Brightener		Blue & Brightener	
Illuminant	*No Bleach*	*Bleach*	*No Bleach*	*Bleach*	*No Bleach*	*Bleach*	*No Bleach*	*Bleach*
Incandescent light	8	7	6	4	5	3	2	1
Cool fluorescent light	8	7	6	4-------5		3	2	1
North light through glass	8	6-------7		5	4	3	2	1
North light, no glass	8	7	6	5	4	3	2	1
Daylight and sunlight	8	7	6	5	4	3	2	1
Twilight	8	7-------6		5	4	3	2	1

AGENTS USED———To establish just which blue dyes and fluorescent brighteners are actually applied to wool raw stock and top in current mill practice, a survey was conducted among raw wool scourers and wool combers, among dyestuff suppliers, and among other sources of technical information.

Processors in Philadelphia and the Delaware Valley were asked not what they used but what they know to be used, identification by *Colour Index* number being sufficient and allowance being made for anonymous reply to a member of the Delaware Valley Section's Intersectional Contest Committee not employed in wool processing.

With respect to wool raw stock, processors were asked what bluing or whitening agents they know to be applied 1) unmixed with other agents, 2) in mixture with other agents, and 3) other than dyestuffs. Similarly, with respect to top, processors were asked what bluing or whitening agents they know to be used on wool top whether present on wool before carding, applied in backwashing or otherwise. Both wool scourers and combers were asked the same questions. Therefore, it should be noticed that in this arrangement, a comber might reply for scouring or vice versa, a processor might report more agents than he is actually using or might even report agents while using none.

From the replies of the processors, the surveying Committee member confidentially compiled the information without any identification of the participating organizations to any other members of the Committee and then destroyed the replies. In Table II, the entry "none" applies only where the processor could not name any bluing or whitening agent used.

On the whole, this survey is likely a very reliable indication of the bluing and whitening agents applied by the mills, owing to the anonymity allowed and judging from the complete response obtained. The cooperation of mill men was excellent. Every processor replied. Some replied directly to the surveying member and freely provided the names of the commercial products used. Some processors were in a position to supply information for both raw stock and top.

Dyestuff suppliers active in the Delaware Valley were asked for their recommendations in questions similar to those asked of wool processors. From eleven inquiries seven replies were received. In some instances these replies may reflect little more than a suggestion for promotional purposes, but more than likely these reflect usage more widespread than in the Delaware Valley. The recommendations thus accumulated are presented in Table II together with results from processors.

Among suppliers, fluorescent brighteners were recommended in

six out of seven cases, which makes fluorescent brighteners the most usually recommended class. Four of the eight fluorescent brighteners react remarkably like 4-methyl-7-diethylamino coumarin. The use of a blue dye simultaneously with fluorescent brightener was recommended by five of the six suppliers recommending fluorescents; anionic blue dyes by three, vat pigments by one, and a cationic by one.

Blue dyes without fluorescent brighteners were recommended by five out of seven suppliers. Acid dyes or a combination of acid dyes, including three triphenylmethane and two anthraquinone dyes, were recommended by four suppliers; a basic dye or combination of basic dyes by two. Pigments were recommended by two suppliers; a vat pigment by one, a mineral pigment by the other.

All replying suppliers made recommendations for both raw stock and top. Five suppliers recommended the same agents for top as for raw stock. Of these, two also recommended one agent for raw stock only. The other two suppliers recommended entirely different classes of agents for raw stock than for top.

In addition to the data presented in Table II, dyestuff suppliers were asked if they supplied any specialty product for bluing or brightening wool and all gave negative replies.

Among the fifteen processor sources contacted for information concerning wool raw stock, thirteen knew of bluing and/or whitening agents being used.

Fluorescent brighteners were mentioned by eleven sources. Fluorescent brighteners applied separately were known by 10. Fluorescent brighteners applied with blue dyes or vat pigments were known by four. In 10 of 11 instances, the sources referred to fluorescent brighteners which act similarly and in eight cases the very same product was mentioned.

Bluing agents on wool raw stock were known to be used by only eight mill sources, acid dyes or combinations of acid dyes by four; a basic dye or combination of basic dye combinations by four, and a combination of basic and acid dyes by four.

No processor reported a substance other than blue dyes or fluorescent brighteners.

Combinations of agents are less often mentioned than single agents, but among processors they are about equal.

TABLE II

Colour Index Notation	Totals — Recommended By Suppliers RS	Top	Used By Processors RS	Top
None	11	11	15	8
			2	4
Acid Violet 17	2		2	1
Acid Violet 43	1	1		
Acid Blue 80	1	1	1	
(Acid Violet 42) (Acid Violet 43)	1	1		
(Acid Violet 17) (Acid Blue 13)		1		
(Acid Violet 34) (Acid Blue 78)			1	
Basic Violet 1		1	2	
(Basic Violet 1) (Basic Blue 9)	1			2
(Acid Red 88) (Basic Violet 1) (Basic Blue 9)				4
Vat Blue 4	1	1		
(Vat Blue 4) (Vat Blue 6)	1	1		
Pigment Blue 29	1	1		
Fluorescent Brightener 23	1			
Fluorescent Brightener (Phorwite BBU)	1	1		
Fluorescent Brightener 30	1			
Fluorescent Brightener 54	1	1	1	
Fluorescent Brightener 52	1	1	1	
Fluorescent Brightener 61	1	1	1	
Fluorescent Brightener 68	1	1	7	1
Fluorescent Brightener (Phorwite WANS)	1	1		
(Acid Blue 80) (Fluorescent Brightener 54)	1	1		
(Acid Blue 143) (Fluorescent Brightener 52)	1			
(Acid Violet 17) (Fluorescent Brightener 68)	1	1		
(Acid Violet 43) (Fluorescent Brightener 68)			3	1
(Basic Violet 1) (Fluorescent Brightener 68)			1	
(Basic Blue—Astrazon Blue 3RL) (Fluorescent Brightener—Phorwite WANS)	1	1		
(Vat Violet 1) (Vat Blue 4) (Fluorescent Brightener 61)	1			
(Vat Violet 13) (Vat Blue 4) (Fluorescent Brightener 61)			1	
(Vat Blue 4) (Vat Blue 6) (Fluorescent Brightener 61)	1	1		

Thirteen different mill sources indicated a total of thirteen different applications for wool stock. Rather than indicating that each mill uses a different material, this may be interpreted to mean that some mills vary their bluing practice and that some mills know of applications in mills not reached by this survey.

For wool top, half of the mill sources knew of no bluing or whitening applications. A fluorescent brightener by itself was reported by one source, a fluorescent brightener with a blue acid dye by two, and an acid dye by one.

Apparently application of bluing and whitening agents appearing on wool top is less common than on raw stock.

As might be anticipated, the number of agents recommended exceeds

the number of agents used. However, it is noteworthy that five combinations used by processors are not recommended by suppliers. That suppliers have not recommended these or even all the components suggests either confidence well kept by suppliers, the operation of suppliers not responding to the survey, or a lack of appreciation of the wool processors' criteria. In two of the used but unrecommended combinations, both components may not be available from one supplier but in all cases this surely indicates that wool processors have made their own decision based upon their own investigations to satisfy needs which they consider critical. Two of these unrecommended combinations are the most widely known combinations. One, CI Acid Violet 43 with CI Fluorescent Brightener 68, is the second most widely known application on wool raw stock and most widely known on top. The other, a combination of acid and basic dyes is equally well known to be used on wool raw stock. In the survey, the proportions of agents in the blend were not requested so that variation in the proportions of blended agents may occur from mill to mill.

American practice, as suggested by this survey, contrasts sharply with the practice in other countries, at least in the United Kingdom and presumably that in Europe, as determined through J C Dickinson (*22*) of the International Wool Secretariat and E B Higgins of ICI (*23*). The former indicates that "The use of optical bleaching on scoured wool or tops could probably now be regarded as negligible. However, bluing of tops in backwashing is still quite common though, as far as we know, it is not usually done on raw wool. The dyestuff most commonly used is CI Basic Violet 3." Similarly, Mr Higgins reports that fluorescent brighteners are practically not used and that bluing, usually with CI Basic Violet 1, is only applied in backwashing by commission combers where color is taken as a criterion of work quality.

The Delaware Valley survey does not include data on the nature of the operation, such as commission, dealer or integrated processor, but it might be expected that, as with bluing of tops in the United Kingdom, fluorescent brighteners and blue dyes are applied to raw stock and top here only where appearance as well as functional qualities are required, viz, in commission or dealer operations and where the wool is not to be colored otherwise.

EVALUATION———Evaluation of bluing and whitening agents entails consideration of tinctorial and fastness aspects.

Tinctorially, the agents must complement the usual creamy color of the fiber. The adjusted color should retain the same hue as natural wool and preferably the hue should not shift significantly more than that of unblued or unwhitened wool in going from one light to another under which wool color might be assessed. The agents must be applicable under ordinary conditions of wet processing to produce the most natural appearance of whiteness. The whitest, for example, the root parts of tippy or stained wools, must not appear blue; tips should not be gray, and one lock should not be obviously bluer than another.

Fastness of the tinted wool to light and to common subsequent wet processing must be such as to avoid difficulties. Data on the fastness of dyeings is available for some agents, but is scanty for many such as the fluorescent brighteners and pigments. Further, the fastness of dyeings in which dye has penetrated the fiber and become fixed is not necessarily the fastness of tints applied in continuous wool processing. The depth of shade used in testing the fastness of dyestuff is much greater than that of tints. The conditions of treatment in standard methods of testing dyeings differ significantly from much of the processing conditions encountered by raw stock and top and are not usually neat for loose forms of fiber.

Therefore, for the evaluation of bluing brightening agents, each agent or combination of agents recommended by suppliers or known by processors to be used was applied to wool raw stock under conditions simulating mill application. Applications to yarn or fabric were ruled out as failing to simulate the physical circumstances for the penetration of liquid flow and for supplying the appropriate natural contamination of wool raw stock. The treated wools were tested for colorfastness to conditions simulating typical subsequent wet processing of raw stock or top.

As a material for test, a quantity of neutral-detergent-scoured, good-color AAA domestic wool entering the rinse bowl was collected and dried to about 16% moisture content in a raw stock dryer at 120°F, thoroughly blended and stored in the dark.

For applying brightening and bluing agents, a composite random sample was drawn, wet out for three minutes in 100 parts of soft water at 120°F, squeezed, and immersed with agitation to simulate rake action for 1.5 minutes in 100 parts of soft water at 115°F containing bluing or brightening agent and enough sulfuric acid to finish the wool with pH near 6.5 except with CI Pigment Blue 29. Pilot tests on five- or 10-gram samples were run to find the amounts of acid and agents needed. For bluing agents, the amount sought was just enough to convert the yellow off-white to the first tint of blue off-white; for brighteners, to approximate the intensity of fluorescence exhibited by a commercial sample considered to be highly brightened. For combinations of brighteners and blue dyes, one half the amount of each was used as for each separately, except for combinations of vat pigments and brightener where more was suggested in the supplier's recommendation. For combinations of bluing agents, the proportions were those suggested or decided by test to approximate the hue of CI Acid Violet 43. For comparison purposes, one sample was similarly stained with fadeable dirt obtained by extraction of tags with ethyl alcohol. Final samples were prepared by running five portions weighing 100 grams each through the same liquors with appropriate additions to the last bowl. Samples were dried to about 13% moisture content in forced draft at 150°F, blended, and stored about one month in the dark.

Fastness treatments were applied to portions of these whitened samples.

For dyeing, a 40-gram sample together with a one-inch strip of 12 fiber test cloth (approximately one gram) was brought to boil in thirty minutes and held at boil for forty-five minutes in two liters of soft water containing at the start 10% Na_2SO_4 owf and 2% acetic acid (56%) owf and, during the boil, enough additional acetic acid to keep pH at 5.5. Samples were squeezed and dried to near 13% moisture at 125°F.

For scouring, a 40-gram sample was immersed 1.5 minutes in each of four baths of four liters of soft water at 120°F containing 0.1% nonionic detergent owl, a nonylphenol with cloud point of 127°F, and 0.2% Na_2SO_4 owl in the first and 0.05% nonionic and 0.1% salt in the second.

Squeezes were accomplished in mill rolls and samples were air dried in the dark.

For carbonizing, a 50-gram sample was immersed for five minutes in one liter of solution at 90°F containing 5% H_2SO_4 owl and 0.01% nonionic detergent squeezed between filter papers through mill rolls and then dried and carbonized at 250°F for 15 minutes. This liquor ratio is short and the acid strong in comparison to best commercial processing, but conditions were intended to allow some approximation of the build-up of matter in the bath with continued running. Drying and baking temperatures were the same for simplicity, the time being that required to accomplish satisfactory carbonization of the samples in the Dietert Moisture Teller apparatus.

For neutralizing, four-fifths of the carbonizing sample was immersed twice for two minutes in each of the three bowls containing four liters of solutions prepared from soft water. The first bath was at 90°F; the second, at 110°F containing 1% soda ash owl; and the third, at 110°F. These conditions were established by tests to finish this wool at pH from 7.0 to 7.5. Between immersions the sample was squeezed in lab rolls, and after the final one, the sample was squeezed between filter papers, through mill rolls, and air dried in the dark.

For dry-in bleaching, a 40-gram sample was worked for 1.5 minutes in 200 ml of three vol hydrogen peroxide and 0.001% nonionic detergent owl, squeezed between filter papers through mill rolls, and dried to near 13% moisture at 125°F.

For rinsing, a 40-gram sample was treated exactly as for dry-in bleaching except without hydrogen peroxide. This provided a reference sample for the dry-in bleached sample from which some coloring matter is also removed in the rewetting and squeezing operations.

For steep bleaching, a 40-gram sample was covered with 200 ml of solution at 130°F containing five vol hydrogen peroxide, 0.06% aqua ammonia owl and 0.01% nonionic detergent owl, worked for two minutes and set in the dark. After 19 hours, the sample was squeezed between filter paper through mill rolls and air dried in the dark.

For lightfastness, carded samples together with AATCC wool lightfastness standards were exposed under glass to mid-August daylight at Philadelphia for 10 days.

TABLE III

Hue of tinted wool

Products used	Parts in mix	Color: Whiteness rank A	Color: Whiteness rank B	Color: Hue rank red to violet Daylight	Color: Hue rank red to violet Incandescent
1) None	—	29Y	27	110	150
2) CI Acid Violet 17	—	17B	9	20G	30V
3) CI Acid Violet 43	—	18R	17	21G	31V
4) CI Acid Blue 80	—	24Y	16	16YG	20G
5) CI Acid Violet 42	1	13Y	11	22G	28V
CI Acid Violet 43	3				
6) CI Acid Violet 17	1	30B	19	17YG	21G
CI Acid Blue 13	3				
7) CI Acid Violet 34	1	14B	18	23G	22B
CI Acid Blue 78	2				
8) CI Basic Violet 1	—	21Y	14	90	5R
9) CI Basic Violet 1	1	19Y	6	18G	24GV
CI Basic Blue 9	1				
10) CI Acid Red 88	1	22R	13	70	3R
CI Basic Violet 1	5				
CI Basic Blue 9	1				
11) CI Vat Blue 4	—	15Y	25	25B	26B
12) CI Vat Blue 6	1	16Y	21	24B	5B
CI Vat Blue 4	1				
13) CI Pigment Blue 29	—	23Y	8	19G	19YG
14) CI Fluorescent Brightening Agent 23	6	26Y	28	140R	17Y
15) Phorwite BBU Ex High Conc	6	27Y	23	120	130
16) CI Fluorescent Brightening Agent 30	6	28Y	22	80	140
17) CI Fluorescent Brightening Agent 54	6	25Y	15	10R	11R
18) CI Fluorescent Brightening Agent 52	6	5Y	1	2R	120R
19) CI Fluorescent Brightening Agent 61	6	9Y	12	3B	70R
20) CI Fluorescent Brightening Agent 68	6	7Y	7	60	60R
21) Phorwite WANS	6	12Y	10	50	90R
22) CI Acid Blue 80	1	20Y	24	130	16Y
CI Fluorescent Brightening Agent 54	34				
23) CI Acid Blue 143	1	11B	20	29B	23GY
CI Fluorescent Brightening Agent 52	130				
24) CI Acid Violet 17	1				
CI Fluorescent Brightening Agent 68	312	6Y	3	27GB	80R
25) CI Acid Violet 43	1	10Y	2	23B	100R
CI Fluorescent Brightening Agent 68	42				
26) CI Basic Violet 1	1	8Y	5	4R	4R
CI Fluorescent Brightening Agent 68	500				
27) Astrazon Blue 3RL		4Y	4	26B	27BV
Phorwite WANS	35				
28) CI Vat Violet 1	1.5				
CI Vat Blue 4	1.0	3R	31	1R	1RV
CI Fluorescent Brightening Agent 61	16.6				
29) CI Vat Violet 13	2				
CI Vat Blue 4	1	1R	30	31B	2RV
CI Fluorescent Brightening Agent 61	16.6				
30) CI Vat Blue 4	2				
CI Vat Blue 6	1	2B	26	30B	29B
CI Fluorescent Brightening Agent 61	8.6				
31) Fadeable Dirt	—	31Y	29	15Y	18YG

LEGEND: R—Red; G—Green; Gr—Grey; B—Blue; V—Violet; Y—Yellow

The color of raw stock was rated visually. The dominant hue of the raw stock under fluorescent lighting and under long-wave ultraviolet and factors such as levelness, dullness, etc, were noted. For further observation, all 248 samples were carded twice. The carded original tinted samples were ranked in hue from red to violet in daylight and in incandescent light with hue being noted by the same observer who rated the raw-stock samples. These carded samples were also ranked in order of whiteness with notation of dominant primary in daylight by two obsevers. As a point of comparison for the visual rating of unbrightened samples and a measure of lightness independent of fluorescence, the reflectance R corresponding to Y in the ICI color system was measured on the Hunter Model D-18 Reflectometer.

For fastness, samples of tinting treatment were ranked in order of decreasing whiteness, the dominant primary noted in cases where whiteness was ranked inferior to the original, and R was measured.

The observers of whiteness, though experienced and familiar with color systems and the principle of whiteness being closeness to the upper end of the color-space axis, held somewhat different but typical concepts of whiteness. Observer A believed that he tended to judge whiteness in the popular sense, aesthetically, as a color in itself with a blue cast being, if not more desirable, at least no more objectionable than the yellow or natural hue if brightness is not inferior. Possibly, too, he may have tended to allow somewhat for excess treatment.

Observer B believed that he tended

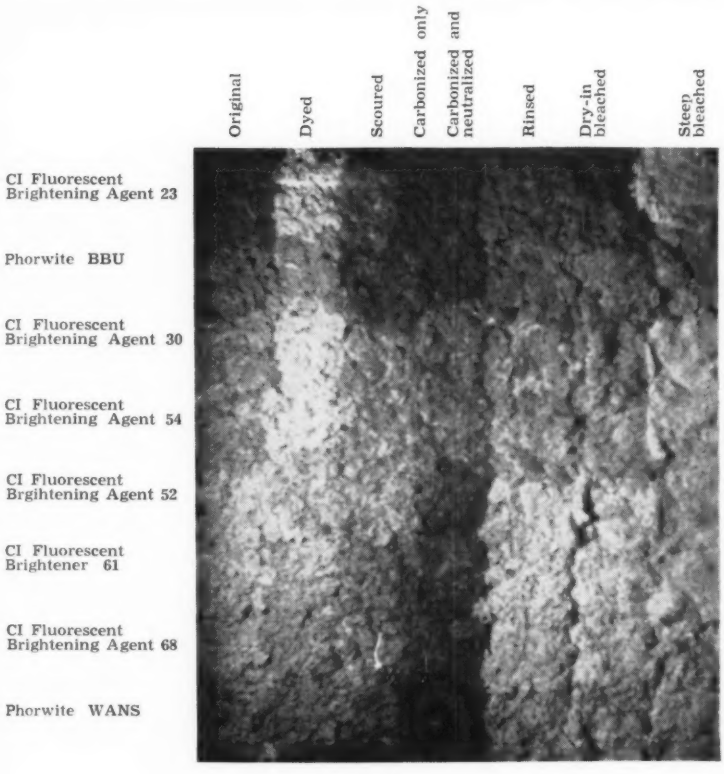

Figure 1
Brightened and processed wool raw stock sample

to judge whiteness primarily on the basis of brightness, technically as a bottom for dyeing permitting the greatest number of potential shades to be dyed on it, and allowing him, the dyer, the greatest freedom in controlling the final color. A blue shade was less bright or light and unconsciously finding his field invaded, he downgraded it.

The observer of hue attempted much finer differentiation of hue than observers A & B. Therefore, his notations of hue are not entirely comparable to theirs. In some instances, the hue was very difficult to decide and the color differed markedly in dullness or whiteness from that of samples next in rank. This is noted in Table III.

The data relating to the visual appearance of the original tints appears in Table III, the data relating to fastness in Table IV, and the data relating to fluorescence in Table V. The fluorescence of the brightened samples and the change in fluorescence resulting from wet processing is shown in Figure 1 on a grey scale. The staining of the twelve-fiber test cloths during the mock dyeing of wool raw stock is shown on a grey scale under daylight and ultraviolet in Figure 2. Among all tables, and figures, the data may be related by means of the identification numbers given.

The results of tinting on production of whiteness are somewhat complicated by small differences in the intensity of tinting and it should be noted that rating was made on the carded stock rather than on the raw stock where primarily the root end is considered. Nevertheless observation of the samples reveals that, with all these bluing and brightening treatments, the apparent whiteness of the fiber is improved except with CI Fluorescent Brightener 23 which under these conditions appears yellower due to the green hue of the fluorescence. Relatively little effect is had from Phorwite BBU, CI Fluorescent Brightening Agent 30, or CI Fluorescent Brightening Agent 54 alone. Under incandescent light, Phorwite BBU has no effect. Blue dyes are generally more effective than these fluorescents alone but not as effective as the last four brighteners. These latter agents exhibit bluish white fluorescence. Combinations of blue dyes and fluorescent brighteners seem in general more effective than blue dyes or brighteners alone according to Observer B and almost as effective to Observer A. A marked exception to this trend is CI Fluorescent Brightening Agent 52 with CI Acid Blue 143 in which the blue dye is the most nearly green of the shading blues. In line with this, the combination of CI Fluorescent Brightening Agent 54 and CI Acid Blue 80 110%, a much less red dye than the other blues used with fluorescent brighteners in these tests, was rated about the same or obviously poorer than CI Fluorescent Brightening Agent 54 alone. In both cases, a third observer found these combinations definitely superior under incandescent light where these best corrected the red hue detected under incandescent light with the fluorescent brighteners alone. Among blue dyes with fluorescent brighteners, Astrazon Blue 3RL seemed to provide the best white, the other blues following in decreasing order of redness. The vat pigment fluorescent combination, owing to the complication introduced by the level of treatment and application, could not be rated reliably. Among dyes alone, the ones ranking highest in production of whiteness gave a violet blue or blue tint but again judgment was made difficult by small differences in the level of tint. Among single agents, CI Acid Violet 17 ranked best from a whitening standpoint. Next among single agents, CI Acid Violet 43, though a trace duller, best met the hue requirement. CI Basic Violet 1 was off to the red and CI Acid Blue 80 was off to the green. CI Pigment Blue 29 was bright but yellow. CI Vat Blue 4 was again hard to judge due to the depth but might fall close to CI Acid Violet 43. Among combinations, the position is of course largely a function of the proportions used here and it must be assumed that, from a hue standpoint, slight variations of the formula may produce superior whiteness. CI Acid Violet 43 shaded with CI Acid Violet 42 produced the highest ranking white among non-fluorescents, possibly because the level applied best approached the optimum, but it may be noteworthy that CI Acid Violet 42 stains very tippy, and in good color wools it is the tips which usually have the deepest yellow coloration. Combination of CI Basic Blue 9 with CI Basic Violet 1 is slightly off to the green and flares green rather than red in

TABLE IV

Fastness of tinted wool

Agent same as Table III	Type Reading	Original Tint	Dyed	Scoured	Carbonized	Agent same as Table III	Type Reading	Carbonized Neutralized	Rinsed	Bleach: Dry In	Bleach: Steep	Light: A	Light: B
1	H	Y	Or3	Or2	Or4	1	H	Or 2	Or 2	Or 2	Or 1	5Y	4B
	R	61.5	63.0	65.9	69.1		R	64.1	63.9	67.2	80.3		
	WA	8	6	5	3		WA	7	4	2	1		
	WB	7	8	5	3		WB	3	4	2	1		
2	H	V3	B4	Or3	OrR2	2	H	Y 3	GB 3	BV 2	Y 1	4R	4Y
	R	60.7	55.6	55.2	61.2		R	68.7	63.1	65.6	84.2		
	WA	7	5	3	6		WA	8Y	4	2	1		
	WB	5	3	7Y	4		WB	8 Or	6Y	2	1		
3	H	VB4	RY4	Or3	V2	3	H	Y3	BV 4	V 5	RV 1	5Y	3B
	R	57.7	57.2	61.5	57.4		R	57.8	60.9	61.2	82.4		
	WA	7	6	4	3		WA	8Y	4	2	1		
	WB	3	6Y	7Y	4Y		WB	8Y	5	2	1		
4	H	G2	BG3	Or3	Or2	4	H	Y 3-4	G Gr 2	G 2	G 2	5B	4B
	R	60.5	58.8	66.3	61.4		R	71.3	64.7	67.0	78.2		
	WA	6	4	5	3		WA	8Y	7	2	1		
	WB	6	5	7	3		WB	8	4	2	1		
5	H	VB4	MV4	Or3	VR1	5	H	Y3	BV 3	V 4	Or 1	5Y	4B
	R	57.8	55.3	61.1	58.1		R	65.7	61.6	61.0	76.1		
	WA	6	7B	3	5		WA	8Y	4	2	1		
	WB	7	8	4	5		WB	6	3	2	1		
6	H	6B	GGr	RV2	Y3	6	H	Y3	G3	G 2	YG 1	4Y	4Y
	R	60.7	59.6	60.6	70.3		R	70.3	63.2	66.6	81.8		
	WA	3	7G	6 Or	8Y		WA	8Y	4	2	1		
	WB	5	6	3	8		WB	8	6	2	1		
7	HFUV	B4	B4	BG 6	V3-4	7	HFUV	Gr2	B1	B3	BV4	4B	3B
	R	58.1	54.7	58.0	62.7		R	62.7	57.7	60.8	63.1		
	WA	6	4	7G	5		WA	8G	3	2	1		
	WB	6	4	7	5		WB	8	3	2	1		
8	H	R 2	ROr 2	Or 2	ROr 2	8	H	Y3	RV 2-3	R2	Gr1	4Y	4Y
	R	59.1	59.9	64.4	59.6		R	62.0	64.3	67.9	83.0		
	WA	5	8	6	3		WA	7	4	2	1		
	WB	7	4	8	3		WB	5	6	2	1		
9	H	B2	G 2	GrG	GGr	9	H	YG 3-4	BG 2-3	B2	G1	4Y	4Y
	R	61.2	59.8	62.5	59.1		R	63.0	59.7	61.2	77.1		
	WA	9	6	3	5		WA	8	3	2	1		
	WB	5	1 Y	6Y	4		WB	8Y	3	2	1		
10	H	RV 3	ROr 2	ROr 1	ROr 2	10	H	Y3	V4	V4	YG1	4Y	3Y
	R	58.2	60.8	63.9	59.6		R	67.3	61.4	63.9	81.4		
	WA	4	7	5	6		WA	8	3	2	1		
	WB	5	6Y	4	7Y		WB	8Y	3	2	1		
11	H	VG 4	YGr 4	Or 3	R 3	11	H	B1	BV4	V5	RV1	4B	3B
	R	54.2	53.4	65.7	54.8		R	60.9	67.0	57.9	82.4		
	WA	8	5	2	4		WA	3	7	6	1		
	WB	7	6	5	4		WB	8Y	3	2	1		
12	H	BGr 4	VGr 4	Or 3	R 3	12	H	B1	BV4	V5	RV1	4B	3B
	R	56.3	52.8	61.4	55.3		R	57.1	53.9	59.1	75.1		
	WA	6	8	3	4		WA	7Y	5	2	1		
	WB	7	6	5	2		WB	8	4	3	1		
13	H	GB 2	GrG 2	Or 3	Gr 4	13	H	Y3	GrB2	BV2	OrR1	5B	4B
	R	60.7	61.0	63.0	61.5		R	65.4	62.7	62.4	80.8		
	WA	3	7Y	6Y	5Or		WA	8Y	4G	2	1		
	WB	4	7Y	6Y	5Or		WB	8Y	3	2	1		
14	H	Y 1	ROr 2	Or 1	YO r	14	H	Y2	YGr 1-2	Y1	Or1	4B	4B
	R	63.8	62.7	66.8	61.9		R	66.3	62.6	65.8	78.2		
	WA	8	3	4	6		WA	7	5	2	1		
	WB	8	2	4	5		WB	6	7	3	1		
15	H	Y 1	Or 2	Or 1	GrR 1	15	H	Y3	Or1	Or1	YGr 1	5Y	4Y
	R	62.7	61.9	63.7	62.9		R	67.2	63.1	66.5	77.1		
	WA	6	4	5	7Y		WA	8Y	5	2	1		
	WB	7	5	4	8		WB	8Y	8	3	1		
16	HFUV	Y 1	Or 2	Or 1	Or 1	16	HFUV	Y2	YG2	YGr 1	YGr 1	4Y	5Y
	R	63.9	61.3	63.6	60.6		R	65.4	64.5	67.6	77.4		
	WA	6	5	3	7 Or		WA	8Y	4	2	1		
	WB	7	5	4	6		WB	8Y	3	2	1		
17	—	Y 1	Or 2	Or 1	OrR 1	17	H	Y2	YG 2	YOr	—	4Y	4Y
	R	65.0	62.3	64.1	64.6		R	67.1	64.4	66.7	81.2		
	WA	6	5	3	7 Gr		WA	8Y	3	2	1		
	WB	6	4	3	7 Gr		WB	8Y	4	2	1		

Agent same as Table III	Type Reading	Original Tint	Dyed	Scoured	Carbonized	Agent same as Table III	Type Reading	Carbonized Neutralized	Rinsed	Bleach: Dry In	Bleach: Steep	Light: A	Light: B
18	H	Y 1	Or 2	Or 1	OrR 1	18	H	Y2	YGr 2	YBR	—	3Y	3Y
	R	62.3	65.1	69.0	69.5		R	67.9	66.3	70.0	79.2		
	WA	4	6Y	5Y	7 Gr		WA	8Y	3	2	1		
	WB	4	6Y	5Y	7 Gr		WB	8Y	3	2	1		
19	H	Y 1	Or 2	Or 1	OrR 1								

Agent same as Table III	Type Reading	Original Tint	Dyed	Scoured	Carbonized	Type Reading	Carbonized Neutralized	Rinsed	Bleach: Dry In	Bleach: Steep	Light: A	Light: B
18	H	Y 1	Or 2	Or 1	OrR 1	H	Y2	YGr 2	YBR	—	3Y	3Y
	R	62.3	65.1	69.0	69.5	R	67.9	66.3	70.0	79.2		
	WA	4	6Y	5Y	7 Gr	WA	8Y	3	2	1		
	WB	4	6Y	5Y	7 Gr	WB	8Y	3	2	1		
19	H	Y 1	Or 2	Or 1	OrR 1	H	Y3	Or1	Or1	YGr1	3Y	3Y
	R	63	61.7	64.1	63.0	R	66.7	64.3	67.7	78.1		
	WA	4	7Y	5Y	6Or	WA	8Y	3	2	1		
	WB	4	6Y	5Or	7Y	WB	8Y	3	2	1		
20	H	Y 1	Or 2	Or 1	GrR 1	H	8Or	Or 1	Or 1	YGr 1	2Y	2Y
	R	63.1	62.3	65.0	64.5	R	Y3	63.2	66.6	80.5		
	WA	4	6Y	5Y	7 Or	WA	64.0	3	2	1		
	WB	4	7Y	5Y	6Y	WB	8Y	3	2	1		
21	H	Y 1	Or 2	Or 1	OrR 1	H	8Y	Or 1	Or 1	YOr 1	3Y	3Y
	R	56.0	55.4	63.7	55.6	R	Y3	61.6	60.7	72.9		
	WA	4	6Y	5Y	7 Gr	WA	63.6	3	2	1		
	WB	4	6Y	5Y	7 Gr	WB	8Or	3	2	1		
22	H	Y 1	BG 1	Or 1-2	Or 1	H	Y3	BG 1	BV 1	B1	4-5Y	4Y
	R	63.1	63.1	64.6	63.3	R	64.0	65.5	68.2	77.7		
	WA	6	4	5	7Y	WA	8Y	3	2	1		
	WB	7	3	6	5	WB	8Y	4	2	1		
23	H	Gr 1-2	Gr 1	OrY 3	Or 2	H	Y3	GY 2	GB 1	GB 1-2	2Y	3Y
	R	63.0	60.6	66.4	61.3	R	69.0	64.4	69.1	79.4		
	WA	4	5	6	7	WA	8	3	2	1		
	WB	4	5G	6Y	7Y	WB	8Y	3	2	1		
24	H	V 1	Or Gr 1	OrY 1	Or 2	H	Y3	GB 1-2	BV 1-2	Y1	2Y	3Y
	R	60.4	59.2	67.7	60.7	R	70.4	62.9	67.4	82.3		
	WA	4	6Y	5Y	7Or	WA	8Y	3	2	1		
	WB	3	6Y	5Y	7Y	WB	8Y	4G	2	1		
25	H	VR 2	Or 1-2	Or 2	Or 2	H	YOr 3	B 1-2	V 1-2	Y1	3Y	3Y
	R	60.7	66.5	63.0	60.2	R	66.6	57.5	66.5	83.9		
	WA	4	5Y	6Y	7 Gr	WA	8Y	3	2	1		
	WB	6	7Y	4	3	WB	8Y	5	2	1		
26	H	R 2	ROr 1	OrR 2	Y3	H	Y3	RV 2	RV 2	Y1	3Y	3Y
	R	62.2	61.0	64.0	63.2	R	69.4	64.4	64.6	79.9		
	WA	3	5Y	6Y	7Or	WA	8Y	4	2	1		
	WB	3	5Y	7Y	6Y	WB	8Y	4Y	2	1		
27	H	B 1	Or Gr 2	Y 1	Or Gr 2	H	YG 2	BG 2	B 1	B 2	3Y	3Y
	R	62.3	67.0	63.6	63.5	R	67.7	61.1	65.6	78.6		
	WA	4	5Y	6Y	7 Or	WA	8Y	3	2	1		
	WB	4	5Y	6 Or	7	WB	8Y	3	2	1		
28	H	V 2-3	V 4	Or V2	RV 3	H	OrY2	RV 3	RV 4	ROr 1	2R	3Y
	R	56.0	55.4	63.7	55.6	R	63.6	61.6	60.7	77.9		
	WA	5	6Y	4	7 Or	WA	8 Or	3	2	1		
	WB	6	5	4	7 Or	WB	8 Or	3	2	1		
29	H	BV 2-3	R 3-4	Or 2	—	H	RV	V 3	V 4	RV 1	2Y	3Y
	R	55.7	53.8	67.6	53.8	R	61.7	67.3	60.6	79.4		
	WA	4	6	7Y	3	WA	8Y	5Y	2	1		
	WB	5	4	6Y	7 Or	WB	8Y	3	2	1		
30	H	B 2-3	B 3	Or 2	B 3	H	GOr 2	B3	B3	B 1-2	3B	3Y
	R	52.4	54.4	66.1	57.2	R	65.3	61.5	60.9	78.5		
	WA	3	5Y	7Y	6Y	WA	8Y	4B	2	1		
	WB	3	5Y	6 Or	7Y	WB	8Y	4	2	1		
31	H	YG 4	YG 5	Y 1	Or 3	H	Y3	YG3	Y4	Y1	5B	4B
	R	56.0	60.0	69.9	51.6	R	69.7	61.4	60.6	76.5		
	WA	8	7	2	4	WA	5	6	3	1		
	WB	8	7	2	4	WB	5	6	3	1		

LEGEND: (*under "Type Reading"*):H—Hue; R—Lightfastness rating from Hunter Reflectometer; W—Whiteness; A—Observer A; B—Observer B; (*under other columns*): R—Red; Or—Orange; G—Green; Gr—Grey; B—Blue; V—Violet; Y—Yellow

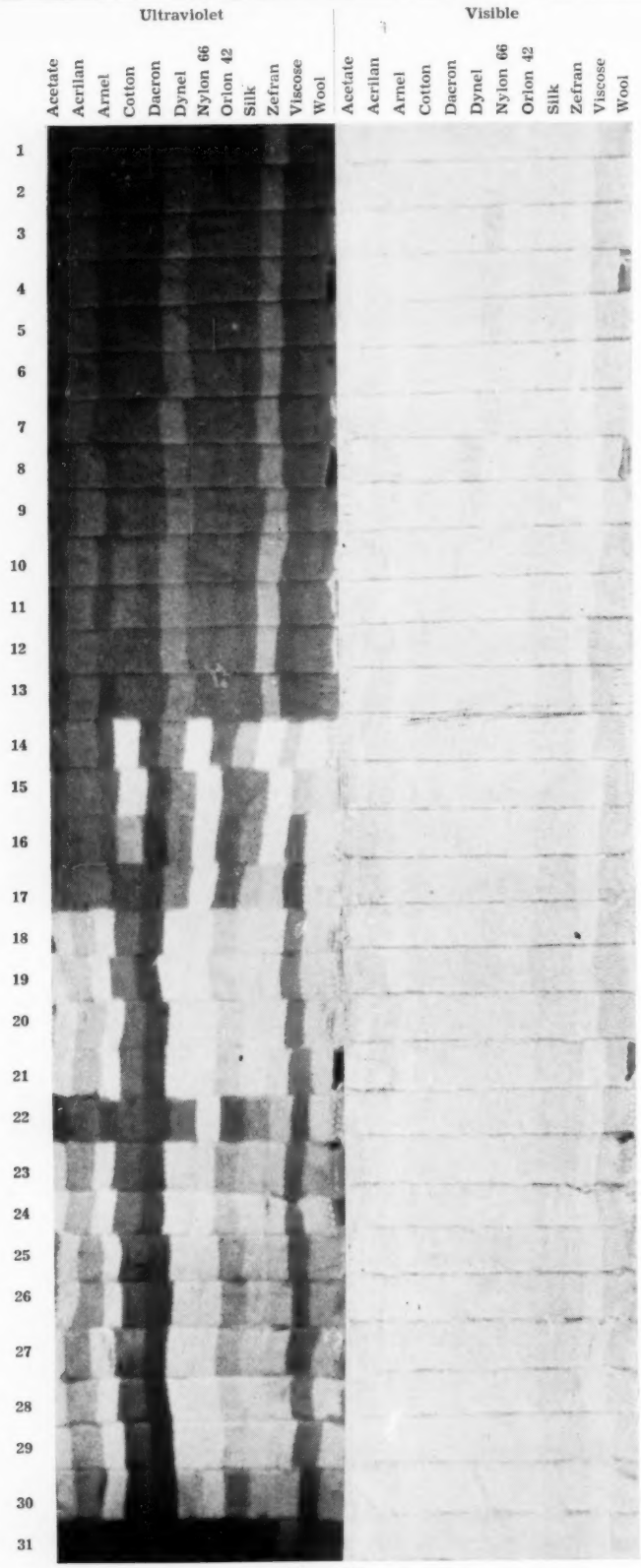

Figure 2
Staining of fibers in mock dyeing brightened and blued wool

artificial light. The combination of CI Acid Violet 34 and CI Acid Blue 78 was relatively bright and slightly green.

The pigments were obviously uneven and required high concentrations in the baths. The combination of CI Acid Violet 17 and CI Acid Blue 13 also showed some unlevelness. Otherwise, levelness of tinting was quite acceptable and tippiness of application at the levels applied was not obvious except in the case of the first four fluorescent brighteners viewed under ultraviolet.

The fluorescence of samples brightened with the last four fluorescents, the most similar ones, is more level than the fluorescence of the original wool. However, with the others, much the opposite appears. Tips, specks of skin and other solid matter are very highly fluorescent while the body of the fiber is only moderately affected. The most spectacular in this respect are CI Fluorescent Brightening Agent 23 and Phorwite BBU; CI Fluorescent Brightening Agent 30, the least. Figure 3 represents an attempt to exhibit, in black and white, the difference between the tippiness obtained with CI Fluorescent Brightening Agent 54 and the levelness with CI Fluorescent Brightening Agent 52 in tinting in the last bowl of a scouring train.

The hue and unlevelness of the fluorescent brightened samples under ultraviolet, Table V, helps to explain the relative ineffectiveness of the first four brighteners in the tables.

The very optimum choice of a bluing agent may depend upon a number of considerations which obtain with any shade matching. The shade desired may vary with the customer's preference, a typical difference encountered is exemplified in the concepts of Observers A & B. Since all of these shades represent complex greys, the effect of color vision as possibly with age becomes important. Illumination by north light or daylight cannot always be assumed. Slight variation in the natural hue or in the hue to be expected from processing, such as bleaching or carbonizing, might be significant. The levelness required for raw stock as such is conceivably different from the levelness for raw stock to be carded for top or yarn making before evaluation. The fastness should be appropriate to avoid difficulties in subsequent processing. By comparing one result against another, the data above is useful in suggesting some possibilities.

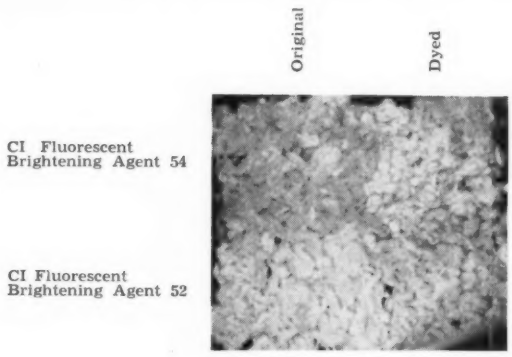

Figure 3

The fastness of the white obtained depends upon the general effect of the process on the natural color of the wool and the effect of the process on the agents applied. The results of processing treatments to assess fastness can be seen from the data in Table V. The effect on natural wool color is indicated in the first row of data.

Scouring ordinarily improves brightness as shown by the increase in R on the original. With blued samples, however, the blue dye may be so much removed that the original yellowness predominates and despite some increase in brightness the stock appears less white.

This is the case with CI Pigment Blue 29. This accounts for the lack of improved whiteness in most cases and explains why the ones heavily tinted with vat pigments are most improved. The tint with CI Acid Violet and CI Acid Blue 78 is less removed or even better developed, and thus appears bluer and greyer. The first four brighteners level somewhat, but the last four and combinations of these all appear weaker.

Carbonizing with sulfuric acid whitens the wool without much affecting the reflectance "R", the color is redder and the tints practically disappear. The vat pigments, CI Fluorescent Brightening Agent 23, CI Fluorescent Brightening Agent 30, to some extent CI Acid Violet 43 and possibly other anthraquinone acid dyes are exceptional. The last four brighteners lose their fluorescence at low pH but the green fluorescence of CI Fluorescent Brightening Agent 23 is enhanced. Unfortunately this does not show well in Figure 1, due to the relative insensitivity of the film to green.

Upon neutralizing, the wool is brighter, as indicated by R, but the wool is yellower and tints are largely removed, producing the most consistent and severe loss of whiteness among these treatments. CI Acid Violet 43, vat pigments. and in spots the first four brighteners alone and in combination show some survival. The remaining fluorescents show good survival, with CI Fluorescent Brightening Agent 30 likely excellent.

Rinsing, due to the efficiency of the mill squeeze, brightens samples somewhat by removing some coloring matter. The agents show some slight loss, but with CI Acid Violet 34 and CI Acid Blue 78, the blue hue increases adding to greyness.

Dry-in bleaching brightens the stock perceptibly as indicated by R, and the least affected tints become more apparent, notably the combination of CI Acid Violet 34 and CI Acid Blue 78 and the last four brighteners and combinations including them. The triphenyl methanes weaken most.

Steep bleaching is unquestionably the most effective whitening influence among these treatments as expected from the strength of the treatment. Apparently all bluing and brightening agents except CI Basic Violet 1 and CI Acid Violet 17 survive to contribute a tint to the bleached

TABLE V

Fluorescence of blued and brightened wool raw stock

			TREATMENTS				Bleached	
Agent no.	*Original*	*Dyed*	*Scoured*	*Carbonized*	*Carbonized & neutralized*	*Rinsed*	*Dry-In*	*Steep*
1 to 13	Tips Y G Body-R Bl	Body 4 Wh	5	4 - 5 Br	Tips 4-5-Y Root 4-5-Bl	5	4-5 G. Br	3 Br Wh
14	Br G Unlevel Specks	1 Bl 1	5-4 5-4 Specks	2-Br G 3 Specks	3W. Bl 4 Bl & Or Or Tips	4-5 Br 5-4 Bl&G Specks	4-5 Br 5-4 Bl & G Specks	1 Bl Br 1
15	Br Y&Bl Unlevel Specks	2-1 Bl 1 Or Tips	4 Bl W 4 Specks	2 Y G W 2 Specks	3 W 3 Or Tips	1 Bl W 5-4	4 Bl W 4 Specks	3 Br Bl 1 Specks
16	Br R B Unlevel Some specks	5-4 Bl Br 1	5-4 5-4	5-4 5-4	4 W Or	5-4 W 5-4 Some Specks	4 Br 5-4	3-2 Br 2
17	Br Y Unlevel Some specks	3 Br 1	4 W	4 W 4	3 W 4	5-4 W 5-4 Some Specks	5-4 Br 5-4	1 Br R 1
18 - 21	V Br Bl Wh Level	3-4 W,R	5-4 WR	2-1 W Or Or Tips	1 W Or Some Bl Wh Spots	4 W	3 Br R	2 Br R
22	Br Y Unlevel Some specks	5-4 Bl BR 1	5-4 5-4	5-4 5-4	4 W Or	5-4 W 5-4 Some Specks	5-4 Br 5-4	2 Br R
23 - 26	Br Bl Wh Level	3-4 WR	4 W	1 W Or Orange	1 W Or Or Tips	5-4 W	4 Br	2 Br R
27	Br Bl Wh Level	3-4 WR R Tips	4 W Or Tips	I W Or	1 W Or Br Spots	5-4 W	4 Br	2 Br R
28, 29	Br Bl Wh Level	3-4 WR	5-4 WR	2-1 W Or	1 W Or	4W	4 Br	1-2 Br R
30	Br Bl Wh Level	3-4 W G	4 W	2-1 W Or	1 W Or	4W	3-4 Br R	1 Br R
31	Tips Y G Body Bl	Body 4 Wh		4 Br	Tips 4-5 Y Root 4-5 Bl	5	4-5 G. Br	3 Br Wh

wool. CI Acid Violet 34 and CI Acid Blue 78 impart a more pronounced hue than in the original tinted stock. Similarly, the fluorescence of brightened samples was generally enhanced, CI Fluorescent Brightening Agent 23 becoming a pure blue and CI Fluorescent Brightening Agent 54 more level and bright. Astrazon Blue 3RL, CI Acid Blue 80 and CI Acid Blue 143 left considerable tints. CI Basic Blue 9, CI Acid Violet 43 and the vats left appreciable tints. The bleach liquors from wools with pigments were quite colored and the removal of applied tints was assisted apparently more by the detergency of the system than by the bleaching action.

Dyeing decreased brightness, as verified by R in most cases, the original and the acid-basic combination being exceptions. With the last four fluorescent brighteners, fluorescence and brightness decreased upon dyeing. With the first four brighteners, leveling occurred and fluorescence and brightness increased. CI Fluorescent Brightening Agent 23 exhibited a complete shift in hue from unlevel yellow green to level bright blue. Figure 3 represents an attempt to illustrate the leveling and brightening of CI Fluorescent Brightening Agent 54 compared to the dulling of CI Fluorescent Brightening Agent 52, representative of the last four.

The staining of some other fibers is detectable in all cases. Illustration of this staining under daylight and ultraviolet in black and white is attempted in Figure 2. Unfortunately, some stains for which hue is unmistakable do not appear in the photograph. The anthraquinone acid dyes all stain nylon distinctly; the triphenyl methane acid dye faintly. All acid dyes also leave traces on wool and silk; the triphenylmethanes appear more distinct on silk. The basic dyes all stain Dynel distinctively; acetate, Orlon, and silk appreciably. CI Acid Red 88 appears as a tint on nylon. Vat pigments and CI Pigment Blue 29 leave a slight trace on Dacron and nylon. Fluorescents appear brilliantly as the photograph in Figure 2 indicates. CI Fluorescent Brightening Agent 23 is a bright white; Phorwite BBU is a trace bluer; CI Fluorescent Brightening Agent 30, violet white; and CI Fluorescent Brightening Agent 54, yellow white. The remaining four are identical in appearance, viz, blue white on acetate, Arnel, nylon, silk; white on wool; pink on Acrilan, Dynel and Vicara, due probably to the color of these fibers. Further, under ultraviolet, the fluorescence of the last four also appear gold on Dacron and olive green on cotton and viscose. The stains from blue dyes alone or with fluorescents have essentially no effect on the color of the fluorescent fibers under ultraviolet.

In lightfastness tests, the greatest shade changes tend to occur with the highest white obtained with fluorescents, that is, whites made with the four most effective brighteners and combinations including them. Relatively smaller shade changes appear in whites with the less effective brighteners alone and in the one combination. The fade in light was to the yellow with all brighteners and combinations including them except with CI Fluorescent Brightening Agent 23, which had initially increased the yellowness of the stock under the conditions of application. The effect of fluorescent brighteners on catalyzing the yellowing of wool in sunlight has been thoroughly studied by Grahm and Statham (*24*). The shade change with fadeable dirt, to which the AATCC Committee on Continuous Wool Scouring Processes directed an investigation (*8*), appears less significant in these tests, than the shade change with fluorescent brighteners or some blue dyes. With blue dyes, shade change suggests whether wool or dye faded more. The triphenyl methane tints fade to the yellow; all others to the blue, except CI Acid Violet 43, for which the change is doubtful.

Conceivably, with particular agents such as the first four brighteners, results might have differed somewhat if a method of application more favorable for them had been used, but these conditions were taken to allow comparisons after a typical method of application in raw stock processing. Nevertheless, in general, these fastness tests suggest potential difficulties.

APPLICATION

Application of brightening and bluing agents can be made at a number of points depending upon the form of wool, mill conditions and the agents used.

For raw stock, the latter bowls of the scouring or neutralizing train are usually used. The last or finishing bowl can be used if pH is well controlled or if the agent is not too responsive to changes in acid added in this bowl to adjust the pH of the finished wool, or if some acidity is required for the agent. The best economy is achieved here. If the brightener solution is acid, a steady flow of this helps to improve the pH control and in some instances, such as with Cape wool, the solution may provide all the acidity required. In shorter trains, the last bowl may be the only choice. However, if the agent tends to tint tippy in acid solution or uneven from lock to lock, if pH control is not precise, or if the agent is appreciably affected by hydrogen peroxide in the last bowl, improved levelness and control may be had by applying the agents in the rinse bowl before the finishing bowl.

In carbonizing, the wool may be tinted before carbonizing, or even in the acid bowl itself. With muriatic acid carbonizing, for example, CI Acid Violet 43 in the acid bowl gives very uniform results. For carbonized only wools, as seen in Table V, the brighteners similar to 4-methyl-7-diethylamino coumarin are useless, and if the stock is to be neutralized, so much of the agents are generally removed, at least at the start, that it is actually found more practical to apply them after neutralizing. With CI Fluorescent Brightening Agents 30 and 54 experience might be otherwise.

In oil added to raw stock for lubrication or antistatic protection, brighteners or, conceivably, blues may be incorporated. Some antistatic oils on the market are remakably fluorescent although the manufacturers disclaim the addition of a brightener, and the fluorescence does, in fact, disappear when the oil is scoured out. In one case, to prepare a commercial undyed natural yarn, a brightener was applied in emulsion before carding and considerable skitteriness appeared in the final carpet. However, a lab test to illustrate this, in which CI Fluorescent Brightener 68 was incorporated in an oil emulsion and sprayed on a white Joria wool before carding and hand spinning, failed to show any significant unlevelness after only one carding. For top, brightening and bluing agents may be present on the raw stock before carding, or be applied in the backwasher, in oiling or conceivably in tinting for indentification.

Technical points in application have practical importance. Unlevelness may result from variations in pick-up due to natural differences from lock to lock as in components of a blend and from tip to root. Most agents mentioned in this paper actually are found, at higher concenrations, to stain quite tippy under

conditions of the last bowl, the basics being possibly the least tippy of the group. The unlevel appearance can be minimized by holding down the level of the tint and by applying the agent in the bowl before last. With pigments, such as CI Pigment Blue 29, and with the first four brighteners a good uniform squeeze is essential to uniform results; however, specks of skin and other matter appear preferentially stained. In the case of mixtures of agents, both must show the same exhaust rates to avoid change in the hue. The overall intensity of tinting must be maintained throughout the run to match all bales or to allow adequate blending in gilling and combing. Fluctuations in temperature or degree of scouring of the lot interfere with close control.

Locks or slivers of wool which have become heavily tinted by being held up in the bath are sometimes found. Brightening and bluing introduces one more factor in matching the scouring of one lot to another. Accidents leading to excessive applications may necessitate rescouring or the toleration of the hue. Some agents are destroyed, at least in part, by hydrogen peroxide used on many wools. The vat pigments require considerable acid to effect tinting at reasonable concentrations in the bath while CI Pigment Blue 28 is sensitive to destruction by acid. Thus, these agents may interfere with normal pH control.

Economically, the cost of blue dyestuffs is negligible, but the cost of brighteners in higher concentrations and the attention required may be considerable. Equipment occupies space and requires maintenance. Solutions must be prepared regularly and correctly without interfering with production or control. Controlling the shade to close tolerance requires someone's attention.

In color matching, the optimum lighting conditions for perceiving differences in an off-white appear to be different than in deeper colors. Bright lighting seems to make the eye strain so against the glare that the eye becomes insensitive to the very small differences present. Even the lighting of commercial color-matching cabinets seems too bright for most scouring millmen and they choose not to use them. More moderate lighting minimizes strain.

Aside from considerations of optimum intensity of illumination for detecting differences in wool color, the quality of light is important. Sunlight, daylight and north light which contain considerable ultraviolet favor the fluorescent of brighteners, as illustrated in Figure 1. Such light, however, is not always available in offices where wool is presented for approval and in mills where wool is being processed. Under artificial lights in the mill, if the color control is run by inspection of the wool running on the machine, great variations in the amount of brightener will occur, particularly as the brightener might be pressed to compensate for variations in the scouring. In such control the use of an ultraviolet lamp is most helpful or the inclusion of a blue dye with the brightener in the stock solution is some help by signalling the approach of excessive treatment by a rise in the blue.

Thus, while the application of brightening or bluing agents is not fraught with insurmountable difficulties, it does require the careful attention of millmen.

SUBSEQUENT PROCESSING

In subsequent wet processing, the influence of fluorescent brighteners and bluing agents applied to wool or wool top to improve apparent whiteness was studied in the laboratory and the mill. In continuous scouring, in blending and in dyeing particularly to light shades or in union with synthetics, difficulties have been reported.

SCOURING ——— In scouring, poorly fixed dyestuffs and brighteners bleed off, leading to a change in shade not always entirely compensating for the increase in brightness occasioned by the removal of soil in the scour. This is to be noted in Table V. Where the scouring operation is continuous, as in rescouring raw stock, in neutralizing carbonized raw stock, in backwashing card sliver or top, in the chain scouring of skeins, etc, more poorly fixed dye bleeds off in the fresh bath than after some running due to build-up of dye in the bath. Continuous refreshment of the baths with fresh water holds this difference down but has a practical limit.

In raw stock rescouring, as might occur preliminary to carbonizing, the fluorescence of wool previously brightened and blued is found to build up with continued running.

To test tailing in backwashing, 25 samples of 54's top weighing five grams each and containing the equivalent of 0.125% CI Fluorescent Brightening Agent 68 owf were passed through a one-liter scouring bath containing 0.05% nonionic detergent owl at 110°F. Then, four five-gram samples of the same top previously acidified with 1% acetic acid 56% were passed through the same bath. Finally, the bath itself was brought to pH 4 with acetic acid, and a five-gram sample of the same top was treated in it for 15 minutes at 120°F. The resulting 25 samples exhibited no apparent difference in brightness. However, this experiment is equivalent to less than seven minutes continuous mill operation. The succeeding four samples, which had been acidified, showed a noticeable increase in white, and the final five-gram sample on which the white in the bath was presumably exhausted, showed an even greater increase, verifying the build-up of whitener in the bath.

In skein scouring of carpet yarn, a mill example was encountered. A natural yarn bearing a fluorescent brightener, upon continuous scouring with nonionic detergent and salt at 145°F in a four-bowl Sargent washer, had such a difference in fluorescence from beginning to end that streaks would have been apparent in a carpet.

For overcoming such difficulties, the use of an initial charge of brightener in the bath is suggested. This entails choosing the correct brightener and the appropriate concentration of it.

BLENDING———In blending, the possibility of streaks has been mentioned. This was investigated in a situation of maximum unlevelness of top. One sample of top was treated with 1% CI Fluorescent Brightening Agent 68 owf and another was left untreated. Two ends of each were combined to form a sample of maximum uneveness and then gilled. Four ends of the resulting sliver were gilled again and the process repeated until four gillings were made. It was found that, after four gillings, the uneven top achieved a remarkably level appearance. Thus it would seem that sufficient blending, such as possibly four gillings with treated and untreated tops, will take care of the appearance of unlevelness, at least in top form.

With raw stock, blending which normally overcomes variations within a blend may be expected to overcome variations in appearance due to differences in brightener applications. Even in the spray application mentioned earlier, unlevelness was not detected visually after carding.

HANDLING ——— In handling brightened wool materials, fading may occur due to the poor lightfastness of the brighteners (*26*). Top exposed over the weekend inside to southern exposure at Philadelphia in January faded noticeably. Over the weekend similar fading might occur on uncovered balls of top, skeins or packages, on yarn set up on a knitting machine, on dyed pieces laid out for cutting, or on finished garments. Any prolonged exposure to light, even diffused light, will result in the fading of the brightener and the amount of visible damage will usually depend upon the degree to which the brightener contributes to the original shade. An extreme example appears in Figure 4. After this package of brightened wool carpet yarn was exposed in the mill for some time, a few turns of the faded yarn were removed to reveal the unfaded interior. With top of raw stock, the faded portions might be carefully blended into the lot so that the faded fibers are no more apparent than the tippiness of the wool. Unfortunately the fading may occur in a form where further blending is impossible. In some instances, however, it has been noted that some brightened samples exposed to light lose fluorescence completely without any obvious loss in whiteness. This suggests that a compensating change is occurring in the wool. It has not been determined whether this fading in light affects subsequent leveling or dyeing.

DYEING———In dyeing wool, the influence of the tint already present on the fiber was considered.

As to possible unlevelness from ununiform tint, an extreme situation in brightness was devised. Samples of the above-mentioned brightened and unbrightened tops were boiled side by side in a solution of 10% NA_2SO_4 owf and 2% acetic acid (56%) owf. The result was complete leveling of the brightener between the samples. Similarly, fiber-to-fiber leveling between wools blended as raw stock can be expected. However, in the case of a highly brightened wool in combination with a closely matching natural or bleached wool, this might occasion trouble. In fact, this happened when brighteners were first being introduced to raw stock scouring some years ago, upon mixing optically whitened wool with the same wool dry-in bleached, possibly also without adequate blending. Such expensive experiments are not likely to be repeated. Fluorescent

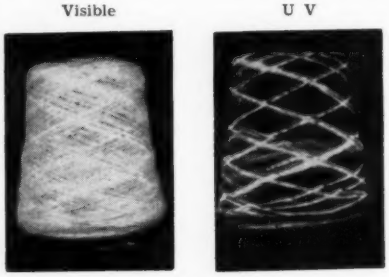

Figure 4

Brightened yarn faded in mill. Some turns removed.

brighteners in the raw-stock-dyeing test leveled well from lock to lock in the sample and migrated well to the wool stripe in the test cloth. Similarly, bluing agents showed leveling from lock to lock with pigments being the poorest. Reputed difficulties such as streaks would not appear likely to result simply from a lack of leveling by the brighteners. Judging from raw-stock test dyeings, bluing agents such as the pigments and acid dyes might show somewhat less tendency to migrate.

An interesting phenomenon was encountered in skein dyeing a bright wool-nylon carpet yarn to a medium shade. Some fibers and parts of fibers remained undyed and fluoresced brightly under ultraviolet. Upon removal from the yarn, these dye-resisting fluorescent fibers were found to be wool and the differences were ascribed to a form of tippy dyeing in which the fluorescent brighteners concentrate in the tips (*27*). Incidentally, in wools brightened with the last four brighteners in the last bowl of the scouring line, concentration of the fluorescence in the tips is not obvious although where the tips are colored, the apparent hue is different, usually salmon or pink, as the blue white light of the fluorescent brightener illuminates or glows through them as through a filter.

Variations in the amount of brightening or bluing agents from one load to another could theoretically lead to some differences in very sensitive shades. Ordinarily in practice, however, for wools dyed in loose forms such variations might be less than the differences which arise from other sources and which are normally hidden by subsequent blending; and for wool dyed in spun forms, such variations might be eliminated by previous blending.

Differences in otherwise uniformly tinted material might possibly arise from differences in the scouring, dyeing or rinsing procedure. The raw-stock scour tests indicated a significant removal of most brighteners and bluing agents. The amount may vary with the intensity of a scour prior to dyeing.

For dyeing variations, 40-gram specimens of raw stock prepared for the appearance and fastness treatments and containing about 0.16% CI Fluorescent Brightening Agent 68 were mock dyed at boil for 45 minutes in two-liter baths containing 10% Na_2SO_4 owf and 2% acetic acid (56%) owf. In one case the sample was removed from the boiling bath and in the other the sample was removed only after the bath had cooled to 140°F. The specimen left in the cooling bath was considerably more fluorescent under ultraviolet.

In another experiment, one sample removed from the boiling dyebath was squeezed immediately and another was placed on a screen without squeezing to drain. After cooling for an hour, it was squeezed and found to be appreciably more fluorescent than the one squeezed immediately. In another experiment, one sample removed from the boiling bath was squeezed immediately and the other rinsed. The rinsed sample looked better under north light but less fluorescent. In mill practice, such variations can presumably be avoided.

It may be that reports of streaks and unlevelness resulting from brightening or bluing agents may arise from factors not connected to the agents as such. For example, one dyer reported unlevelness which occurred because the dyestuffs were entered before checking the starting pH of the stock. Unfortunately, the pH was unusally low, possibly as a result of attempts to achieve exhaustion of the brightening or bluing agents at an earlier process (*28*).

The effect of metal ions was considered with one brightener in quick tests by mock dyeing specimens of the wool raw stock. Dyeings were made in 50:1 liquor ratio with 0.16% CI Fluorescent Brightening Agent 68 owf, 10% Na_2SO_4 owf and acetic acid to pH 5 with four ppm iron owl, with two ppm copper owl, with 3% EDTA (34%) owf, and with 5% sodium hexameta phosphate owf. After one-half hour of boil, the fluorescence of the specimens under ultraviolet was noticeably improved with the sequestering agents, and considerably reduced in the specimens contaminated with metals. In visible light the color of the wool contaminated with these

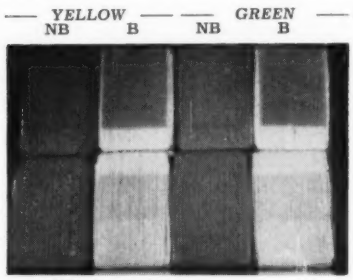

Figure 5
Lightfastness test specimen under ultraviolet light

high levels of metal ions was much poorer but the effect appeared due more to discoloration by metallic ion contamination than to a simple reduction in fluorescence.

None of these dyeing results or observations, except perhaps tippy dyeing, appears to be the necessary result of applying brightening or bluing agents, but may suggest some possible difficulty occasioned by their presence.

SHADE MATCHING———Appreciable quantities of fluorescent brighteners may be troublesome in light and pastel shades, due to the flare in different lights. As an example, light green carpet shades prepared with and without CI Fluorescent Brightening Agent 68 were found to shift unmistakably with respect to each other in change of lights. In natural north light, the yarn with fluorescent brightener appeared bluer, and under incandescent or fluorescent light, the yarn without fluorescent brightener looked bluer. The lighter the shade the more susceptible it would be to such influence. Matching a nonfluorescent standard shade on a brightened wool under both lights can become a problem. To a large extent the effect depends on the shade. Light blue and blue greens are most susceptible. In yellows and yellow greens, as illustrated in skeins dyed with 0.1% yellow and with and without 0.5% CI Fluorescent Brightening Agent 68, both showed obvious difference in fluorescence and might be expected to appear washed out under natural lights, but the difference is hardly noticeable.

On pastels, however, the influence of brighteners and blue dyes is of course more obvious and in fact, the incorporation of fluorescents in the dye formula may be the only practical way to get the desired brightness for some shades. Nevertheless, with brighteners in very light shades, practical difficulties partly related to lightfastness are encountered in dyehouse operation. For example, with appreciable amounts of fluorescents in the formula, in bright shades, dyehouse working standards require more frequent replacement due to fading (27). Further, shade matching difficulty becomes appreciable at a level corresponding to approximately 0.1% CI Fluorescent Brightening Agent 68 owf. The difficulty is more pronounced on the night shifts.

FASTNESS———The fastness of dyeings on wool brightened and blued depends largely upon the extent to which these tints contribute to the ultimate shade. The lighter the shade and the more sensitive the shade to alterations of yellow and blue, the greater the apparent effect.

As an example of shades in which the fluorescent brightener contributes negligibly to the shade, the yellow and green wool carpet yarns mentioned above were exposed in direct sunlight and in the Fade-Ometer as illustrated in Figure 5. After two days' exposure in direct sunlight, brightener fluorescence had almost disappeared, but a difference in the brightened sample could not be detected without difficulty even in sunlight. After 20 hours in the Fade-Ometer, all four showed a noticeable break, but no difference between brightened and unbrightened samples.

As an example of shades in which the fluorescent brighteners contribute noticeably, samples of wool carpet yarn dyed to a light blue with 0.1% CI Acid Blue 80 and with and without 0.4% CI Fluorescent Brightening Agent 68 were exposed in a window with southern exposure from June 23, 1959 to July 2, 1959 and in a Fade-Ometer. After this daylight exposure, fluorescence was much reduced and in the brightened sample a considerable change was apparent in north light. In the unbrightened sample, only a negligible change was detected. After five hours in the Fade-Ometer, the brightened sample had changed considerably but the unbrightened sample only negligibly. The exposed shade of the brightened sample in both cases appeared a trace to slightly more yellow than the unbrightened original.

As an undyed natural carpet yarn, samples exposed to the same daylight as the light blue and in the Fade-Ometer for five, 10 and 20 hours, showed similar but less-obvious changes. In the brightened sample, there was a noticeable change to the yellow, and in the unbrightened there was a negligible trace of yellowing. In the Fade-Ometer, a noticeable break occurred at five hours on brightened sample and the original showed a slight change at 20 hours.

Thus brighteners, and presumably fugitive blues, can affect the lightfastness of dyeings depending upon the ultimate shade. The effect of brighteners may possibly be more noticeable in very light shades than on the natural.

Wetfastness of these blue dyed shades was tested according to AATCC Standard Test Method 1-1957 "Colorfastness of Wool Textiles to Mill Washing and Scouring." In all four tests, the brighteners stained acetate brightly; nylon, silk, and wool very faintly. The brightened shade, while it lost much of its fluorescence, still looked less yellow except after Test No. IV.

In drycleaning according to AATCC Test Method 85-1957, both brightened and unbrightened blue dyed yarns seemed noticeably more yellow. The fluorescence of the brightened yarn was noticeably reduced, but in north light the shade change of the brightened sample was not greater than the unbrightened. It is suggested that the decreased fluorescence results wholly from the yellow increasing in drycleaning.

DYEING BLENDS———In dyeing blends of wool and other fibers migration of the brightening and bluing agents may be important.

As an indication of which fibers might be stained by the bluing and brightening agents, the agents known to be used or suggested for tinting wool raw stock and top were applied under neutral and in some instances under weak acid conditions to common natural and synthetic fibers. The results for all agents under neutral conditions and for most brighteners

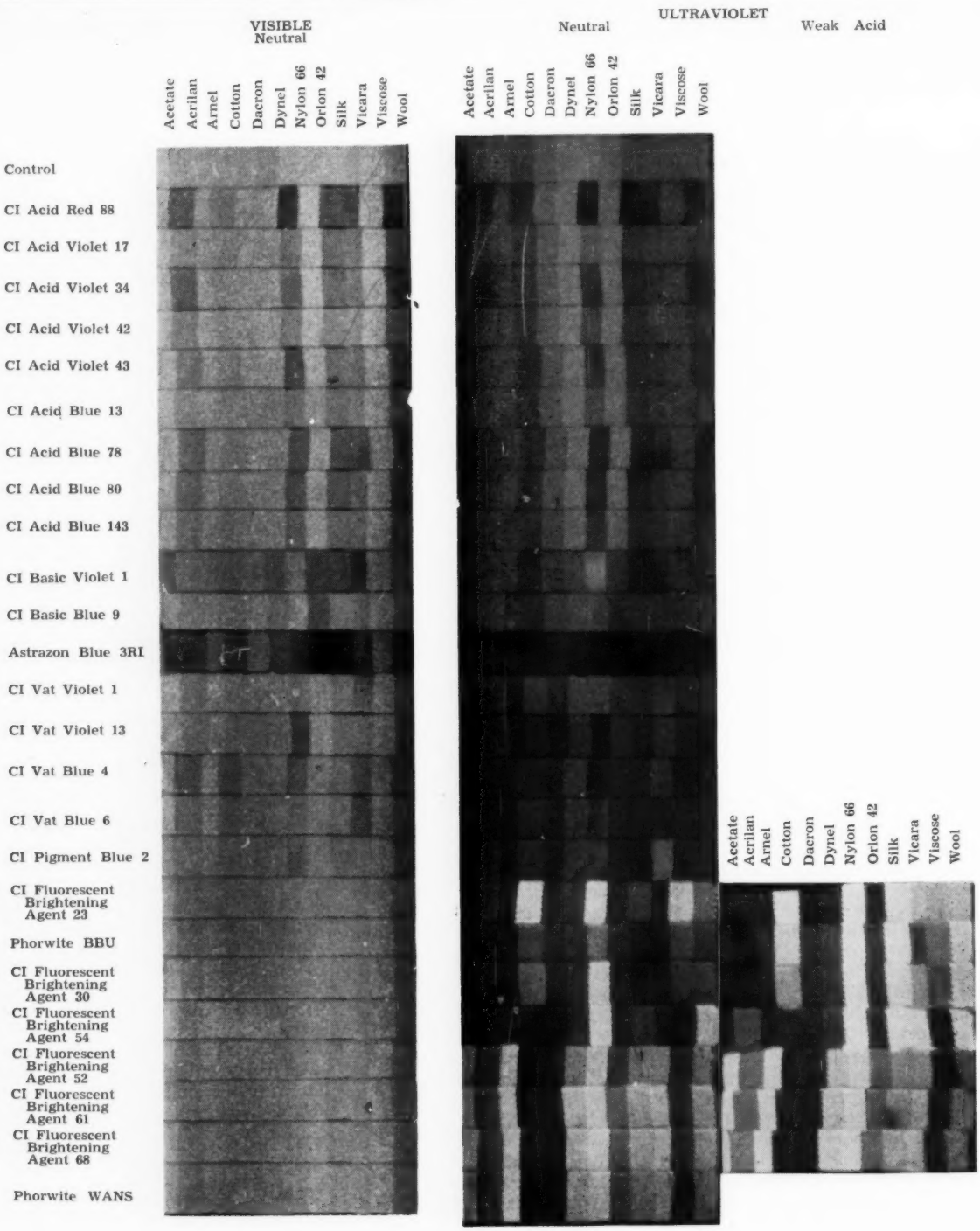

Figure 6
Fibers stained by brightening and bluing agents

under weak acid conditions are shown in Figure 6. With bluing agents, wider staining tendency is apparent than in the raw stock dyeing tests shown in Figure 2. The wider staining tendency of Phorwite BBU and CI Fluorescent Brightening Agents 23, 30 and 54 under weak acid conditions can be noted. The first three show relatively less tendency to stain wool under neutral conditions.

To test the significance of agents transferring from tinted wools to various synthetics, as suggested by

the screening tests, a series of experiments was carried out. As bluing agents, CI Acid Violet 17 and CI Basic Violet 1 were chosen since these showed the widest range of fiber staining under both neutral and weak acid conditions, and since these represented different types of dye from a dyeing standpoint. As brighteners, CI Fluorescent Brightening Agents 54 and 68 were chosen as these represented variations of agents actually known to be used. From the standpoint of exhaust under neutral and acid conditions and noticeable bluing or whitening effect in the screening tests, these four agents appeared most efficient. The quantity of dyes to apply was determined experimentally to produce a just-detectable difference; of brighteners to approximate the highest level encountered commercially assessed under ultraviolet. These agents were applied by a method designed to simulate application in the last bowl of a scouring train, but to simplify handling and evaluation of results, yarn was used as the form for test.

Six samples were treated at 30:1 for two minutes at 110°F in baths of two-vol hydrogen peroxide to which additions were made as listed in Table VI. The wool was then squeezed through rolls and air dried in the dark.

For blends, five-gram samples of each brightened wool were paired with equal samples of Acrilan, Creslan, Dacron, nylon 6, Orlon 42 and Zefran, and Wool #1 with nylon 66. Each blend was mock dyed at boil for 45 minutes under neutral conditions using 10% Na_2SO_4 owf, under weak acid conditions using 0.56% AcOH and 10% Na_2SO_4 owf, and under strong acid conditions using 3% H_2SO_4 and 10% Na_2SO_4 owf.

Further, Wool # 1—nylon 6 was mock dyed under each condition with 1% Resolin B, a nylon blocking agent; Wool #1-Orlon 42, with Retarder N.

The resulting samples were examined visually in daylight and under ultraviolet. Those prepared from Wool #1 and Wool #6 are pictured in black and white in Figures 7 and 8 as they appear under ultraviolet, allowance being made for the somewhat lower intensity of illumination at the edges of these arrays.

In no instance was the transfer of blue dyes noticeable, largely due to the minute quantities initially applied. Nor was any effect of the blue dyes on the migration of the brightener observable. The fluorescence of samples prepared from Wool #1 with CI Fluorescent Brightening Agent 68 was practically identical to that of samples from Wools #2 and #3; from Wool #6 with CI Fluorescent Brightening Agent 54 and CI Basic Violet 1 to that of samples from Wools #4 and #5.

All brightened wool samples became noticeably dull and yellow in dyeing partly due to the reversion of the bleached wool color in dyeing and partly due to the loss of fluorescence, the loss of fluorescence increasing with increasing acidity in the dyebath. To preclude the effect of pH on the fluorescence of brighteners, samples were soaked with a solution of 10% aqua ammonia and air dried. In Figures 7 and 8, the lower half of each dyed pair and the adjacent undyed brightened wool sample was neutralized this way. The principal effect was the further yellowing of the dyed wool. Where fluorescence of the wool diminishes with pH of the dyebath and the fluorescence of the synthetic does not increase, removal of some brightener by the dyebath is assumed.

In all blends, the brighteners transferred to some extent; almost all with nylon, almost none with Dacron.

With Acrilan the greatest transfer of CI Fluorescent Brightening Agents 54 and 68 occurred under neutral conditions, less under weak acid conditions, and none under strong acid conditions.

With Creslan, CI Fluorescent Brightening Agent 68 transferred under all conditions, the greatest neutral and the least under strong acid conditions. CI Fluorescent Brightening Agent 54 transferred to Creslan under all conditions, the greatest under strong acid and the least under neutral conditions.

With Dacron, CI Fluorescent Brightening Agent 68 transferred only slightly under neutral and weak conditions. Apparently CI Fluorescent Brightening Agent 54 did not transfer.

With nylon 6, CI Fluorescent Brightening Agent 68 transferred under all conditions, the greatest taking place under neutral conditions. CI Fluorescent Brightening Agent 54 also transferred under all conditions but with the greatest under weak acid conditions. With nylon 66, similar results were obtained. On nylon 6 the presence of a nylon blocking agent resulted in an increase of transfer of CI Fluorescent Brightening Agent 68.

CI Fluorescent Brightening Agent 68 transfers to Orlon 42 under all dyeing conditions, with the greatest taking place under neutral and the least under strong acid conditions. CI Fluorescent Brightening Agent 54 transfers to Orlon 42 only slightly under strong acid conditions with none noticeable at neutral and weak acid conditions. The presence of the retarder resulted in an increase in transfer of CI Fluorescent Brightening Agent 68.

With Zefran, CI Fluorescent Brightening Agent 68 transferred under all conditions, the greatest under weak acid and the least under strong acid conditions. CI Fluorescent Brightening Agent 54 transferred under all conditions, the greatest under neutral and the least under strong acid conditions.

From these results it may be inferred that the presence of fluorescence brightener on the wool portion of a blend would cause no difficulty in union dyeing of medium to relatively flat light shades where a different class of dyes is used to dye each fiber because compensating corrections can be made in the dye formula. In the production of bright light shades, however, even though different classes of dyes are used for each fiber, a better union will be obtained if a naturally white wool is used in the blend, and not one which will become dull during processing because of the loss of white or color reversion due to residual peroxides.

Where bright medium or light shades are to be dyed union on wool and nylon, where the same dye must be used on both fibers, it is imperative in quality work to use the whitest natural wool available and to blend well before spinning. The use of a strongly bleached wool containing a fluorescent brightener in such a blend will always result in a muddy shade after dyeing because of the transfer of brightener from wool to nylon and reversion of color of the wool. If the stock is very well

TABLE VI

Wool sample	*Additions to bath, owf*
#1	0.5% CI Fluorescent Brightening Agent 68
#2	0.5% CI Fluorescent Brightening Agent 68 8 ppm CI Acid Violet 17
#3	0.5% CI Fluorescent Brightening Agent 68 12 ppm CI Basic Violet 1
#4	0.5% CI Fluorescent Brightening Agent 54 0.4% AcOH
#5	0.5% CI Fluorescent Brightening Agent 54 0.4% AcOH & 8 ppm CI Acid Violet 17
#6	0.5% CI Fluorescent Brightening Agent 54 0.4% AcOH & 12 ppm CI Basic Violet 1

blended before spinning, this muddy effect is not quite so noticeable; however, extra steps in blending and difficulty in dyeing may easily cancel out any cost advantage that might be expected from the use of a cheaper wool.

In 100% wool blend, this same effect can cause trouble where a naturally white wool and a strongly bleached and fluorescent brightened wool which may appear exactly the same in raw stock form are inadequately blended or possibly spun separately and the yarns subsequently mixed. Any subsequent wet processing as suggested by the raw-stock fastness test, even a scour at 120°F, will result in brightening of the naturally white wool and dulling of the bleached wool which can be successfully covered only in darker shades.

FADEABLE DIRT

The occasional occurrence of a significantly brightened wool which does not fade upon exposure to light despite disappearance of fluorescence as detected under ultraviolet, and the fact that brightened wools usually fade in light to the yellow or brown while wools with fadeable dirt brighten to a less yellow shade, provide the possibility of designing correction for fadeable dirt through the use of fluorescent brighteners. In the work of the AATCC Research Committee on the subject, the suggested methods of removing fadeable dirt entailed expensive chemical and mechanical processing, such as carbonizing, preferably with additional treatment by sodium bisulfite (*8*). The application of brightener would be considerably more economical.

The feasibility of compensating for fadeable dirt by fluorescent brightener was investigated in an experiment wherein a natural carpet yarn was purposely contaminated with fadeable dirt obtained by the alcoholic extraction of tags alone and with this fadeable dirt and 0.4% CI Fluorescent Brightening Agent 68. These samples were comparable with the natural and brightened natural samples, dicussed under lightfastness of dyeings on brightened wool, and simultaneously exposed with them to daylight in a window and in the Fade-Ometer. After nine days' exposure to daylight, the sample with fadeable dirt was noticeably bleached in appearance, and the sample with fadeable dirt and brightener, slightly to noticeably more yellow. This indicates that fadeable dirt may be compensated for by fluorescent brightener and, incidentally, also that brighteners may be a more significant influence on wool color than fadeable dirt in some instances. In the Fade-Ometer at five, 10 and 20 hours, the sample with fadeable dirt was bleached in appearance noticeably, but the sample with fadeable dirt and brightener was slightly to noticeably more yellow.

After these experiments, it was learned (*27*) that such application of brightener was used in a commercial dyeing. In this instance cited, about 0.8 oz/100 lbs of CI Fluorescent Brightening Agent 68 was determined as the proper amount.

Quantitative expression of the

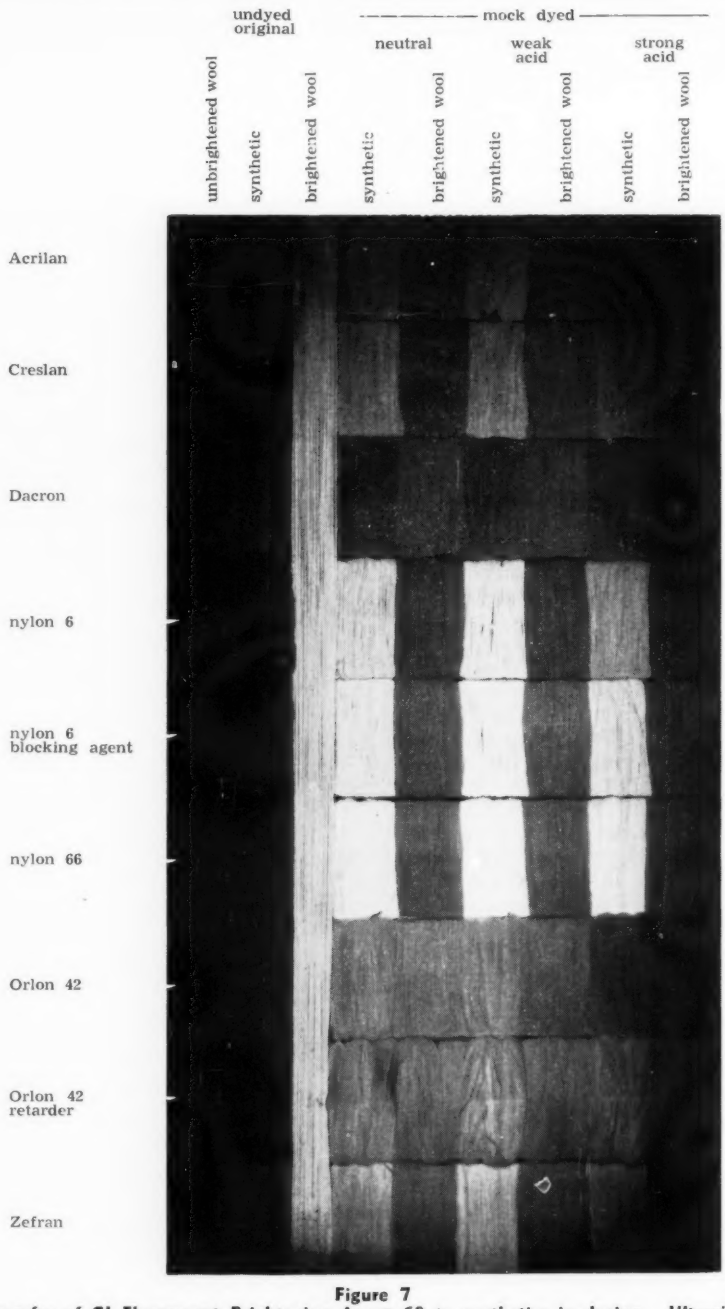

Figure 7
Transfer of CI Fluorescent Brightening Agent 68 to synthetics in dyeing. Ultraviolet.

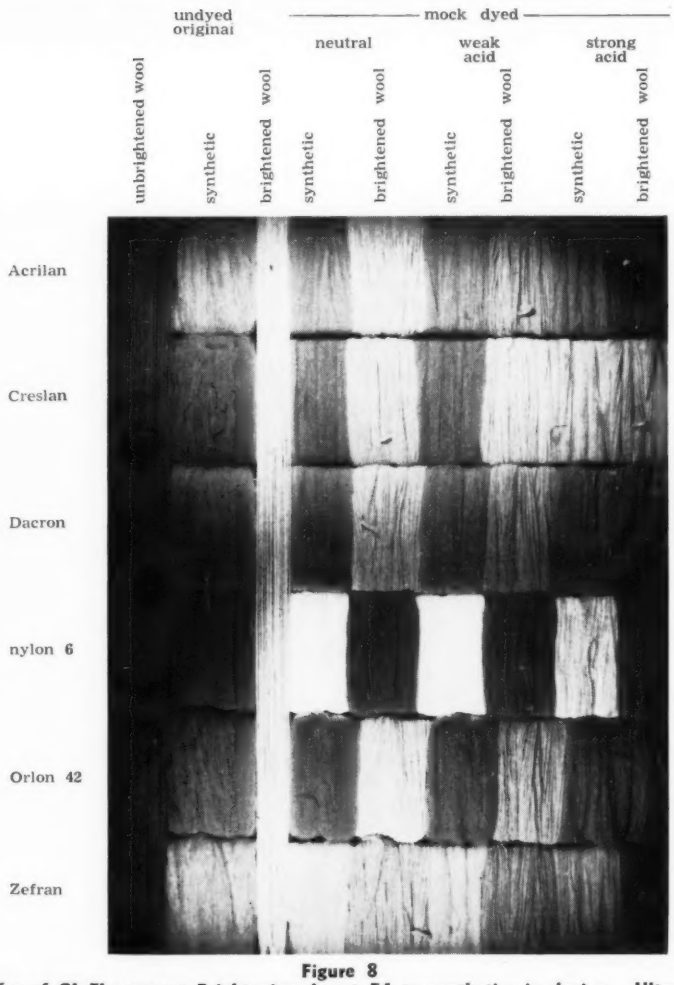

Figure 8
Transfer of CI Fluorescent Brightening Agent 54 to synthetics in dyeing. Ultraviolet.

amount of brightener required for a given amount of fadeable dirt may be desirable. However, determination of this ratio is complicated by a number of factors. The amount of fadeable dirt determined by the cold-alcohol extraction method of the AATCC Research Committee on raw stock may not reflect the fadeable dirt in the form to be dyed. Generally it is found that wools dyed after carding present less of a dirt problem than wools dyed as raw stock. The essential difference lies, no doubt, in the removal in carding of the particular matter which acts as a reservoir for fadeable dirt in raw stock dyeing and in the efficiency of the scour which yarns are given before dyeing. A more precise relation between stock dyeing result and cold-alcohol extraction test may be needed. Some data on the relative survival of dirt and brighteners to processing preparatory to dyeing would be helpful. In any case, the application of the precise amount of brightener in raw stock scouring to provide optimum compensation for fadeable dirt would seem fortuitous without some actual experimental correlation with subsequent processing. With top, the problem is generally less prevalent and variations of subsequent processing less complicated. The appropriate point for application of brightener then would more likely appear to be in the dyeing operation itself.

TESTING

The detection of brightening and bluing agents has not received much attention.

For fluorescent brighteners, the simplest and most popular method of detecting a fluorescent brightener is the observation of its fluorescence under ultraviolet light. The method is usually quite reliable for higher concentrations of brighteners but if the stock is in the carbonized only condition, at least the fluorescent brighteners which are listed last do not fluoresce. The method is not always reliable in lower concentrations as laboratories have reported finding brightener where none was applied and observers of a group of wools often guess that a brightener is present although none has been applied. To study sources of interference with this test, a sample of Kentucky fleece wool was separated into tip and root portions. Samples of each portion were extracted with chloroform, with hexane, and with hexane followed by ethyl alcohol. A portion of these was rinsed in running soft water.

The observations on the samples extracted with chloroform are typical. The extracted tips were a bright green yellow, the root ends a violet blue under ultraviolet. The extracts were spotted on a porcelain plate and allowed to dry. The residues all fluoresced under ultraviolet, the extract from tips appeared pink or salmon, from the roots less pink and brighter. When the root extract was spotted on the extracted tips, and the tip extract spotted on the extracted root, the tips were still green yellow but the roots with the tip extracts were pink. The specimens fluorescing pink all were shades of brown or yellow under north light which possibly explains the hue under ultraviolet. Upon water rinsing, all fluorescence increased probably due to removal of soil. The water extract spotted and dried also appeared fluorescent. Fiber extracted with ethyl alcohol was more yellow or brown and thus appeared somewhat less white under ultraviolet. Refined lanolin is also fluorescent Thus, it seems sufficiently established that the fluorescence of wool measured earlier on the Cary Fluorescence Spectrometer is natural to wool and may be influenced by the presence of substances other than brighteners.

Further, the raw-stock samples dyed for fastness test purposes are found noticeably more white or fluoresecnt under ultraviolet and the bleached samples appear appreciably whiter. Thus the fluorescence also appears to be affected somewhat with processing.

To test the fastness of natural wool fluorescence, two yarns were spun by hand, one of fine shorn Cape, the other of fine domestic pulled wool. Specimens of each of these were treated with weak and strong acids,

and with strong alkali; extracted with chloroform, with carbon tetrachloride, and with ethyl alcohol after carbon tetrachloride; bleached with hydrogen peroxide, chlorinated as for shrink-resistance and stripped with sodium sulfoxylate formaldehyde. All yarns remained fluorescent, very slight differences in intensity and hue being as expected from other changes in the near white colors.

As apparent in Figure 5, even yarns dyed without brightener show a slight fluorescence which is extinguished after the exposure to light. To determine if this fading might be expected from natural wool and not chance contamination, all of the treated hand spun yarns were mounted and exposed in direct sunlight for one and two days and in the Fade-Ometer for two and one-half, five, and 10 hours. The same sharp break appeared in each yarn. So, this would not provide a distinction of natural fluorescence from brightener fluorescence.

For bluing agents, the appearance of excessive bluing and the occurrence of blue locks are unmistakable. However, when blue has been applied more skillfully to disguise the true yellow coloration of the wool, the blue is not easily determined, at least quantitatively. Significant amounts of bluing agents flatten or depress the spectrophotometric reflectance curve between 520 and 640 mμ where otherwise the curve of unblued wool usually rises with gradually decreasing slope. The situation is complicated by the variety of agents and blends which might be present and the relatively large amount of contamination with respect to bluing agent.

For example, upon extracting tinted wool samples with pyridine or glacial acetic acid in an ordinary soxhlet, the first two cycles are tinted, but upon continued running the extract does not appear blue colored but amber as wool grease tests extracts usually appear. Luttringhaus (*29*) has found that by extracting CI Basic Violet 1 from wool with glacial acetic, evaporating almost all solvent and spotting on filter paper, one ppm of the agent could be determined by comparison with a blank. Again unfortunately control samples are not always available. Presumably by redyeing the extracted dye (*30*) on a small piece of multifiber test cloth, some classification as well as detection might be possible.

A simple test, such as boiling off 20 grams of wool with about 10% ammonia and redyeing on a ½" strip of 12-fiber test cloth with raveled edges, followed by a boil off in hydrochloric acid solution and redyeing at pH 6, detected within the possibility of classification five ppm of all the acid and basic dyes tested and 50 ppm of CI Pigment Blue 29. However, comparison with direct dyeings on multifiber test cloth show poor recovery by boil-off methods. Further greater sensitivity is required to cover the range needed.

Thus the determination of small quantities of bluing and brightening agent is still not simple or reliable, although extraction and selective redyeing offer fair promise of satisfaction.

Thus it appears that the way to a simple quantitative test has been pointed out but the actual establishment of its reliability is still underway.

SUMMARY

The wide variety of brightening and bluing agents for wool raw stock has been determined by a survey of wool processors and dyestuff suppliers. These agents, applied to wool raw stock under representative conditions, were evaluated for efficiency and fastness to ordinary wool processing. The practical aspects of application have been discussed. The effect of these agents on subsequent processing, particularly dyeing, has been studied. Reported possibilities of steakiness or unlevelness due to them have been considered experimentally and the transfer of brighteners to synthetic fibers in blends shown to be serious. The compensation for fadeable dirt is suggested with qualifications, and the difficulties in detecting small quantities of these bluing and brightening agents is reviewed on the basis of tests.

The presence of fair quantities can be detected under ultraviolet for brighteners, and in visible light for bluing agents, but the determination of smaller amounts is complicated by the natural fluorescence of wool and the presence of other extractable matter.

Brightening and bluing agents can improve the white appearance of wool obviously, combinations of bluing and brightening agents being more satisfactory under varying lighting conditions. Generally, significantly improved wool color showed greater loss of whiteness in subsequent processing. Application in continuous processing requires special attention and whitened wools may occasion difficulties in subsequent processing, most signficantly in affecting shade matching and lightfastness of light shades and in migrating to synthetic fibers in blends.

Unless a wool is to be left natural in the final product, the imporved appearance may lead to difficulties in subsequent processing without doing anything which the dyer cannot do possibly better.

ACKNOWLEDGMENT

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American Cyanamid Co
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Philadelphia Textile Institute
Philadelphia Wool Scouring & Carbonizing Co
Verona Dyestuffs
Fred Whitaker, Inc

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1960 AATCC CONVENTION

Auspices of the Delaware Valley Section

October 6, 7, 8 • Philadelphia, Pa

CHARLES N KUZMA JR, Amalgamated Chemical Corp, hotel chairman for the 1960 Convention, has made arrangements at three of Philadelphia's outstanding hotels to accomodate the many visitors expected to attend the three-day meeting on October 6, 7 and 8. The Sheraton Hotel, one of the Quaker City's newest and finest, will be Convention headquarters, with adequate facilities available for exhibits and meetings. The Warwick and Drake Hotels, conveniently nearby, will also make available additional accomodations.

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Warwick Hotel

Pennsylvania Room, Sheraton Hotel

Delaware Valley Suite, Sheraton Hotel—a typical meeting room

Grand Ballroom, Sheraton Hotel

The Warwick Room, Warwick Hotel

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No designation after name indicates Senior
(A) indicates Associate
(J) indicates Junior
(S) indicates Student
* indicates transfer from another class of membership

July 13, 1960

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Paul J Derwent
Yao-Chung Tsai
Zaven H Barsoumian (A)

Correction

Your attention is called to the inadvertant omission of eleven names in the roster of Committee RA60, which appeared on page 27 of the July 25 issue.

The correct roster is printed below:

COMMITTE RA60
COLORFASTNESS TO WASHING

V D Lyon, chairman
E Gula, secretary

R C Allison	**E G Jones**
C H Bayley	**W N Pardey**
R W Boyer	**F J Rizzo**
V L Chase	**R E Rupp**
J F Corbett	**G M Smith**
R E Derby Jr	**R B Smith***
H B Dixon	**A W Spencer**
E S Dunlap	**R L Stutz**
F Fortess	**G C Ward**
P J Fynn	**G S Wham**
R K Gagnon	**M W Winkler**
W A Holst	

*Immediate past chairman (1957-59)

Employment Register

This column is open for two insertions per year, per member, without charge. Blanks may be obtained from, and filed with, the secretary of the Association, Post Office Box 28, Lowell, Mass. It is understood that these will be open to inspection by prospective employers who can obtain further information from the secretary.

60-11

Education: AB, Harvard, majoring in chemistry.
Experience: Chemist, consultant, general manager and new product analyst.
Position desired: Product or process development as director.
Location: No preference.
Age: 54; married, four dependents; reference upon request.

7-25, 8-8

60-12

Education: BS, North Carolina State College; Lieut (jg), USNR.
Experience: Print chemist.
Position desired: Finishing chemist (dyeing-printing-finishing).
Location: Piedmont or Southeastern Section.
Age: 37; married; two dependents; references.

8-8, 8-22

Membership Applications

JUNE 30 - JULY 6, 1960

Delaware Valley Section

Senior

Joseph L Franken—Colorist, Berkshire Color Co, Inc, Reading, Pa. Sponsors: I Wolder, A C Tressler

Michel W Frank—Chemist, Scholler Brothers, Inc., Philadelphia, Pa. Sponsors: C A Seibert, R F Graupner

Metropolitan Section

Senior

Wlliam E Bartle—Production mgr, Color & Chemicals Div, Interchemical Corp, Hawthorne, NJ. Sponsors: W W Chase, H L Young

Piedmont Section

Junior

Joel P Kendrick—Asst chemist, Burlington Industries, Cramerton, NC. Sponsors: D J Latta, B B Moss

Georgia Institute of Technology

Student

Jack R Farmer—Student, Georgia Institute of Technology, Atlanta, Ga. Sponsor: W Postman

July 6-13, 1960

Metropolitan Section

Senior

Eric Altherr—Head of application lab, Chem Div, Sandoz Inc, New York, NY. Sponsors: R Noordtzij, C W Saalfrank.

Junior

Richard L Pepin—Textile chemist, Sandoz Inc, New York, NY. Sponsors: C W Saalfrank, C H A Schmitt.

Hudson-Mohawk Section

Junior

Jerry M Peck—Dyer, Newton Line Co, Homer, NY. Sponors: G M Kidder, G R Thompson.

Piedmont Section

Senior

K Woodrow Moore—Laboratory mgr, Judson Mills, Greenville, SC. Sponsors: G Cocoros, C K Batson.

Non-Affiliated

Transfer to Senior

Tomas Furth—Asst superintendent, Sudamtex do Brasil, Rio de Janeiro, Brazil. Sponsors: G M Kidder, G R Thompson.

July 14-20, 1960

Delaware Valley Section

Senior

Richard R Correll—Dyer foreman, Blue Ridge Textile Co, Bangor, Pa. Sponsors: W Tschinkel, L L Gregoire.

Metropolitan Section

Senior

James B Henderson—Mgr, Process dev dept, Shell Chem Corp, New York, N Y. Sponsors: R J Cullen, G R Ferrante.

Franklin M Soling—Merchandising & product dev, American Viscose Corp, New York, N Y. Sponsors: A R Wachter, W E Scholer.

Gerhard A Wolff—Mgr, Putnam Chem Corp, Beacon, N Y. Sponsors: L E Moody, W J Ratcliffe.

Mid-West Section

Senior

George W Cogswell—Senior dev chemist, A E Staley Mfg Co, Decatur, Ill. Sponsors: E H Grosse, R H Boggs.

Pacific Northwest Section

Senior

Fred W Phillips—Supv of finishing, Jantzen Inc, Portland, Ore. Sponsors: C E Bouthillier, R E Newman.

Non-Affiliated

Senior

Henry Offner — Chief chemist, plant mgr, B Herzog Comercio E Industria S/A, Sao Paulo, Brazil. Sponsors: G J Mandikos, G R Thompson.

News of the Trade

VDI Reports Findings on Market Potential for Colored Sheets, Pollow Cases

A huge potential market exists for colored sheets and pillow cases, including more than half of U S households which now use only white bedclothes, according to facts revealed in a nationwide survey conducted by The Vat Dye Institute, nonprofit association of ten American dyestuff producers.

The survey's purpose was to bring to light how the women of America feel about the use of color in the domestic products they buy, including sheets, pillow cases, towels and tablecloths. The results, tabulated from scientific motivational and population sampling research techniques, are being offered freely as a service to the domestics industry.

Primary among statistical facts revealed, say the Institute spokesmen, is the finding that only 36% of America's housewives have ever bought colored sheets (including solid shades or fancies). These represent just 19% of the total sheet inventory; colored sheets are found in 47% of US homes.

In addition, it was learned that, in only 8% of all U S homes does color constitute more than half of sheet inventory. In half of colored-sheet-owning homes, color is a relatively small proportion—¼ or less—of sheet inventory.

The significance of these figures to the industry's profit opportunities, the Institute points out, is shown by the further fact that the average inventory of 32 sheets in "color-oriented" households is 18% higher than the comparable average of 27 sheets and cases found in "white-oriented" homes. This percentage difference is a measure of the sales increase possible—actually more than 150 million sheets in 52 million homes of the US—by overcoming resistance of "white only" housewives through the appeal of color, the Institute reports.

To determine the underlying reasons for the apparent lag in acceptance of color in domestics, The Vat Dye Institute first ordered a series of preliminary studies conducted in 1959 by Consumer Behavior Research Associates. Using motivation research methods in depth interviews of a representative group of 167 housewives, it was learned that receptiveness to color is strongly influenced by certain psychological factors that cut across class lines, age brackets and other classifications.

Chief among these factors is the "deep symbolism" found in the perception of white as a color or "absence of color" in consumer's minds. For example, white-oriented women see white as being cleaner, more sterile and pure; and any color to them is by definition a masking of white. Color-oriented women, on the other hand, see white as a possible useful decorator color, and do not think white is necessarily cleaner than color.

Interestingly, preliminary research revealed that the psychological factors leading some women, the "color-resistors", to reject color in sheets do not carry over to towels or tablecloths. In fact, says the Institute, color acceptance in these domestic items is practically universal, and they were therefore dropped from further study.

A third major factor tending to inhibit acceptance of color in sheets is related to consumers' habits of thrift frugality. Thus, it is shown the color-resistors buy sheets less frequently and in smaller quantities, and only when their current supply is worn out. "Color-acceptors" are shown to be more generous spenders, willing to try new products, maintain larger supplies.

These and other detailed findings of the initial motivation study served as a basis for a group of hypotheses formulated and put to test by The Vat Dye Institute through a nationwide survey. Carried out by W R Simmons & Associates in interviews with 2,000 women representing a cross-section of the population, the results are said to be about the same as would be achieved by a complete census.

In addition to the national statistical averages concerning sheet inventories and buying practices, the survey highlights such fact as:

- — Housewives in the 30's and 40's are more apt to buy color than younger or older women;
- — Color-acceptance rises moderately with income scale;
- — Most popular sheet and pillow case colors (apart from white) are pink, blue, yellow and light green, with lavender fifth;
- — High-school- or college-educated women tend to be somewhat more receptive to color;
- — Color acceptance is greatest in the South, least in the Midwest, about equal in the Northeast and West.

Probably the most important practical obstacle to color acceptance in sheets indicated by the Institute survey is the prevalent consumer opinion that colored sheets will fade in washing. Seven out of ten women who have never owner colored sheets were found to believe that colors fade, streak, run or change in laundering, drying or in regular use. In addition, more than half the women think that colored sheets represent extra trouble in laundering, such as the need for washing in separate loads or for not using regular bleaches. These misconceptions are especially meaningful in light of the survey's statistical fact that four out of five women wash their sheets at home, it is pointed out.

Directly related to this is the finding that a large percentage of consumers are uninformed on the significance or meaning of the terms "fast colors" or "vat dyed," and therefore are not assured that colored sheets can be washed without taking special pains.

To meet these obstacles so as to reflect positively in the greater sale of higher-profit colored sheets, says the Institute, a broad educational job is needed. The consumer must be informed that properly dyed sheets can be thoroughly washed and do not fade and from the psychological standpoint convince them that they can get their colored sheets immaculately clean.

Regarding the question of price, the survey indicates that women naturally expect colored sheets to be higher priced than white. Price is a major obstacle with the white-oriented, frugal-type consumers. However, it also showed that many women have an exaggerated idea of the extra cost of color. In this respect, the Institute suggests, both mills and retailers might find it advantageous to educate women to the fact that the price differential is small and is more than offset by the special advantages of colored sheets.

Other pertinent factors revealed in the survey, including the advantages for colored sheets cited by women are:

1) *Stays Fresh, Cleaner Looking Longer*—Half the women think that white sheets become soiled

or look ready for changing sooner than colored ones; 40% say it makes no difference; only 10% say a colored one needs changing sooner. This is a distinct sales advantage for color if handled right, says the Institute.

2) *Fashionable*—Colored sheets are considered "smart", "fashionable", "modern", "a change", while white by contrast is often classed as old-fashioned, passé.
3) *Decorative*—A great majority of women regard colored sheets as an additional element of room decor, often associated with emotional values, such as "cool, soothing greens and blues."
4) *Appropriate for Guest Rooms*—Most women, including non-owners of colored sheets, find them particularly suited for use in guest rooms.
5) *Suitable for Children*—More than half the women regard colored sheets and cases as especially suitable for use in chlidren's rooms. This was related to consumer ideas that children like color, and color does not show dirt as much.
6) *Good as Gifts*—Three out of four women selected colored sheets as gift possibilities.
7) *Husbands Don't Matter*—The real or suspected opposition to color in the bedrooms by husbands is not a serious obstacle. Women say most husbands feel "it makes no difference" or "I'll leave it up to my wife."
8) *Different Color for Different People*—Women discriminate in selecting colors for specific purposes or people. Definite color patterns were noted in selections for guest room, teen age son or daughter, girl or boy, gift giving.

Complete documentary findings of the motivational research and statistical nationwide survey are being presented by The Vat Dye Institute to domestic textile mills and retail merchandise executives. The presentation program includes a special film and booklet which have been published to summarize the research for the industry.

Naylor

According to James L Naylor, president of the Institute, it is not the Institute's purpose to detail merchandising programs to mills and stores, but rather to make concrete marketing suggestions of a broad nature for profitable use by the industry.

The basis of these suggestions, Mr Naylor reports, is summed up in the Institute's research-backed position that "color is the key to profit in sheets and pillow cases, including over-all volume as well as higher unit profits."

Mr Naylor, in an address entitled "Color—The Key to Profit in Sheets and Pillow Cases" stated that extra profit almost always goes hand in hand with extra value or quality, a lesson American businessmen have learned well in their continuing efforts to earn a rightful reward for goods produced and sold.

"In textiles quality has to do with the basic fiber, how it is spun into yarn, how woven and how constructed into useful products, such as apparel, decorative fabrics or sheets. A most important element in this process is the quality of the colors put into the fabrics.

"To help in the industry's aim at quality was the primary purpose for the formation of The Vat Dye Institute. Our objectives and working goals are clearly stated: to raise color quality standards by encouraging the use of the fastest dyes for the ultimate in consumer satisfaction, and also, to help broaden the applications of color in the textile industry generally. In these objectives the interests of member companies coincide with those of the business community they serve.

"The mills that produce dyed fabrics and the firms that manufacture products using these fabrics have a common stake in the broader acceptance of color. In many cases, colored goods provide a higher profit margin. Color also introduces the priceless factor of fashion or style, which has proven its power of stimulating consumer sales.

"Such was our reasoning regarding the potential for color in sheets and pillow cases. As veteran textile people we knew some of the answers. So did our mill and retail merchandise friends. But the answers were not enough. It was the questions themselves—the 'why'—we were after. Only then would we have the key for interpreting the known factors, and be able to do something constructive for the industry we serve.

"We believe that the findings of the Institute's consumer motivation and nationwide survey have provided that key—in fact a whole chain of keys—through better understanding of consumer wants and needs.

"The effective use of this understanding—this new knowledge—can, we hope, help the industry take advantage of the significant fact shown in the survey—the existence of a tremendous untapped market potential for colored sheets. With it, of course, goes the opportunity for greater profit potential through more volume with better mark-up, through color."

The survey on domestic products is the first major market study conducted by The Vat Dye Institute since its organization in 1956. Devoted primarily to increasing and expanding he use of quality color in textile products, the Institute's members include: American Cyanamid Co; Arnold Hoffman & Co, Inc.; Chemical Manufacturing Co, Inc; E I du Pont de Nemours & Co, Inc; General Dyestuff Co, Div of General Aniline & Film Corp; Hoechst Chemical Corp; Koppers Co, Inc; National Aniline Div, Allied Chemical Corp; Toms River Chemical Corp; and Verona-Pharma Chemical Corp.

Headquarters of the Institute are in the Empire State Building, Fifth Avenue, New York 1, NY.

General Calendar

AMERICAN COTTON MANUFACTURERS INSTITUTE
Mar 23-25 (12th Annual Meeting, Fontainebleau Hotel, Miami Beach, Fla)

CANADIAN TEXTILE CONFERENCE
Feb 7-9 (Queen Elizabeth Hotel, Montreal, Quebec, Canada)

CHEMICAL EXPOSITION USA
Sept 13-15 (Statler Hilton Hotel, New York, NY)

THE FIBER SOCIETY
Oct 27-28 (Fall Meeting, Washington Hotel, Washington DC)

INSTRUMENT SOCIETY OF AMERICA
Sept 26-30 (Annual Meeting, Instrument-Automation Conference and Exhibit, New York, NY)

INTERNATIONAL TEXTILE MACHINERY EXPOSITION
1962 (3rd Exposition, Hanover, Germany)

NATIONAL COTTON COUNCIL
Sept 28-29 (9th Chemical Finishing Conference, Statler Hotel, Washington, DC)

SOUTHERN TEXTILE EXPOSITION
Oct 3-7 (Greenville, SC)

SYNTHETIC ORGANIC CHEMICAL MANUFACTURERS ASSOCIATION
Sept 13, Oct 11, Nov 10, Dec 8 (Hotel Roosevelt, New York, NY)

TEXTILE TECHNICAL FEDERATION OF CANADA
Sept 7-8 (Seventh Canadian Textile Seminar, Queen's Univ, Kingston, Ont, Canada)

TEXTILE OPERATING EXECUTIVES OF GEORGIA
Oct 22 (Harrison Hightower Bldg, Georgia Inst of Technology, Atlanta, Ga)

WORLD CONGRESS FOR MAN-MADE FIBERS
May 15-18, 1962 (2nd World Congress, London, England)

METRO-ATLANTIC SOFTENERS

the most complete line of softeners for every textile use

A softener for your specific need— or — a minimum combination of softeners that will supply the most diversified and complete processing requirements.

NAPSOFT D

Anionic softener designed to produce a full lofty hand on napped goods.

ATCOSOFT S

Nonionic silicone softener producing the durable silicone wash-wear hand.

ATCO FINISH SRF

Exceptional soil resistant anionic softener.

ATCOSOFT S-100

Anionic softener for maintaining brighter colors.

ATCOSOFT PE

Nonionic polyethylene emulsion for increased tear and abrasion resistance.

soon to be released

REZSOFT NI

Nonionic reactant non-chlorine retentive versatile softener.

ATCOSOFT SD

Economical cationic softener for plain quality finishes.

D-STAT

Antistatic softeners, durable cationic, anionic, nonionic types.

REZSOFT CW

A highly substantive cationic softener for use with resins.

ATCOSOFT N

Economical anionic softener for plain quality finishes.

CHEMICALS METRO ATLANTIC DYESTUFFS

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Flexol Epoxy Plasticizers; Unox Epoxides

Commercial-scale production of a new family of epoxy compounds is now underway at the Institute, W Va, plant of Union Carbide Chemicals Co. This new unit, producing Unox epoxides and Flexol epoxy plasticizers, is now on stream. Because of the success of the operation, Carbide is also announcing reduced prices for several of the epoxides.

The epoxy plasticizers (Flexol EPO, JPO, and EP-8) are said to be effective, low-cost stabilizers and plasticizers for vinyl chloride resins. Their synergistic action with many metallic vinyl stabilizers reportedly increases the resistance of vinyls to heat and light degradation.

Flexol EPO, used in vinyl formulations, has excellent long-term compatibilty, stabilizing action, and resistance to both color development and rancidity, it is claimed. Flexol JPO differs from Flexol EPO by having a lower oxirane oxygen and higher iodine number. Both Flexol EPO and JPO reportedly can be used to improve vinyl products such as calendered film and sheeting and coated fabrics.

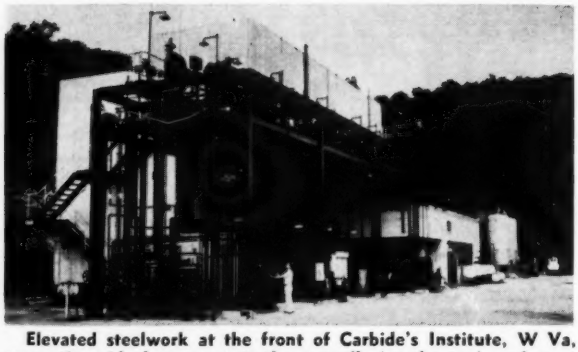
Flexol EP-8 is designed for use in vinyl chloride resins where flexibility as well as heat and light stability are desirable at low temperatures. It also is said to reduce the dilatancy problem of plastisols used in high-speed coating operations. It reportedly contributes good hand and drape as the low-temperature plasticizer in vinyl film and sheeting.

The epoxides (Unox epoxide 201, 206, and 207) are the only commercial-scale epoxides with cyloaliphatic structures that eliminate the light-unstable phenolic groups found in conventional epoxies which are based on epichlorhydrin and bisphenol A, it is claimed.

Unox 201 is described as the most versatile of the diepoxides. It reportedly can be formulated to give a wide range of high-temperature properties, toughness, cure speeds, and handling characteristics. The properties claimed for it (low viscosity, high heat-distortion temperatures, good electrical characteristics, color stability adhesion, fast reactivity, and compatibility with low-cost hardeners) point to several end uses, including cross-linking applications.

Unox 206 is said to be unique among the epoxides in that it is reported to have a viscosity nearly equal to that of water and is a solvent for many solid anhydride hardeners. As a reactive diluent for conventional epoxy resins, it is said to lower the viscosity without the usual sacrifice in heat-resistance properties of the cured resin. It can be used as a chemical intermediate or as a monomer to make polyglycols containing unreacted epoxy groups. The combination of heat resistance and toughness found in Unox 206 castings is said to be unusual. Ucet Textile Resin 11-74, which is based on epoxide 206, shows excellent potential for imparting crease resistance to cotton fabrics.

Unox 207's compact structure reportedly makes possible epoxy plastics with outstanding high-temperature, physical, and electrical properties. Its low combining weight is said to be an advantage when used to cross-link or modify low-cost resins and polymers. Unox epoxide 207 resins resist stress at temperatures up to 592°F, it is claimed.



Elevated steelwork at the front of Carbide's Institute, W Va, peracetic acid plant supports the catwalk (at the top) and most of the process piping. The reinforced concrete structure behind the steelwork houses the process reaction equipment. D G Santini, supervisor at the plant, is shown making a valve-setting adjustment.

●

Yardney Chemical Adds Product Marketing

Ions Exchange and Chemical Corp, New York, NY, has changed its name to Yardney Chemical Inc. At the same time, it assumes the marketing functions of Yardney Chemix Corp, until now sole U S sales agent for Ions Exchange products.

President Michel N Yardney explained that this action will enable the efficient centralization of all related activities within the same company.

Among the products developed by the Yardney organization is Eversan, an antibacterial treatment for textiles.

It is expected that Yardney Chemical Inc will announce shortly the development of several new products. They include a treatment that is said to make nylon more receptive to a larger variety of dyes, and that also renders nylon breathable and wettable.

Eastman Starts Construction of New Service and Development Laboratory for Chemicals Division

Construction has started in Kingsport, Tenn, of new quarters for the sales service and product development laboratories of the Chemicals Division of Eastman Chemical Products, Inc, subsdiary of Eastman Kodak Company. Completion of the building is scheduled for early 1961.

Erection of the new building reflects a constant expansion in the variety and extent of the work of the chemical laboratory units since they were established eight years ago. The function of these laboratories is to aid the company's customers in the most efficient use of Eastman's industrial and specialty chemicals, as well as to develop markets for new and existing products. The laboratories represent an important group in the Eastman Chemical Products organization, which markets the products of Tennessee Eastman Company in Kingsport, and Texas Eastman Company in Longview, Texas.

The new laboratory building will consist of a basement and two floors totaling 60,000 sq ft. When the new building is occupied, the Chemicals Division laboratories will include the following groups: Plastics, Protective Coatings, Antioxidants, Functional Fluids, and Low Molecular Weight Polyolefins (including textile finishes).

Other groups planned include the study of dyes for synthetic textiles and the physical testing of products.

The new building will be open to visitors. The space now occupied by the Chemicals Division laboratories will be taken over by the Eastman Fiber Development Division laboratories.

Harshaw Diversified Products for the textile industry

ORGANIC PIGMENTS

For cotton printing and dyeing

DYESTUFFS

Disperse • Alizarine • Chrome • Acid

SHARPRINT CARRIER

Trademark

For maximum results on polyester fibers, many printers find the addition of Harshaw Sharprint Carrier to their disperse printing pastes solves the difficult problem of low color yield and lack of sharpness.

NF AND TECHNICAL

Tannic acid • Pyrogallic acid
Gallic acid • Benzoquinone

For more information about the items listed above write to:

ZINSSER DIVISION
The Harshaw Chemical Company
Hastings-On-Hudson 6, N.Y.

ZINC FLUOBORATE 40%

Zinc Fluoborate finds use as a curing agent for "wash and wear" finishes on textiles. Advantages claimed for Zinc Fluoborate as a curing agent include: (1) short curing time—one to two minutes at the curing temperatures required; (2) high crease resistance; and (3) low chlorine retention. Users also report that there is less tendency for polymerization to occur in the bath when Zinc Fluoborate is used.

ZINC NITRATE FLAKE

Harshaw Zinc Nitrate Flake is especially suited for polymerizing resins currently being used for wrinkle-free and wash-and-wear fabrics.

TYPICAL AVERAGE ANALYSIS

Zn	25.20%
FE	0.001%
Pb	0.005%
H_2O Insoluble	.008%
pH of 5% solution	5.1%

For more information about the items listed above write to:

THE HARSHAW CHEMICAL COMPANY
1945 East 97th Street
Cleveland 6, Ohio

HARSHAW

Calcozine Acrylic Dyes

A new line of dyes for true and modified acrylics that reportedly requires no retarders in the dyebath has been introduced by American Cyanamid Co. The new coloring compounds are said to offer a different approach to acrylic dyeing. According to Cyanamid, other acrylic dyes have a strong affinity for the fiber, necessitating the use of retarders, whereas the attraction is controlled in the new dyes through an increase in the number of positive electrically charged dye sites on the individual dye molecule.

Five colors make up the initial line, with development work proceeding on others. Cyanamid suggests that the most interesting of the five starters to the trade is Calcozine Acrylic Violet 3R, a rich purple which is said to be "totally unlike any color that dyers and users of acrylic fibers have previously been able to achieve." Other colors in the present product line are blue, red and two shades of yellow.

Because the new Calcozine dyes require only common salt and acetic acid for even exhaust and level dyeings, the need for retarders is eliminated, and more rapid penetration and shorter dye bath cycles is the result, it is claimed.

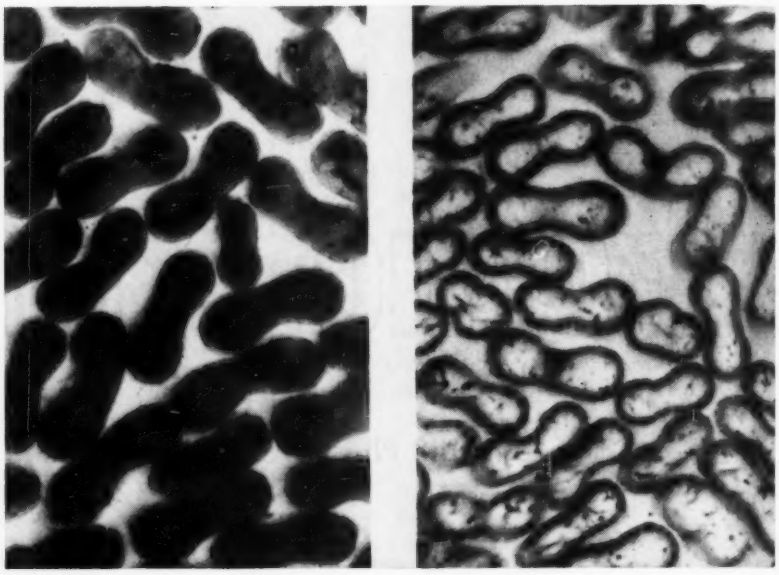
Because of the elimination of retarders, and the level dyeing features, which shorten the dyeing cycle, Cyanamid believes that savings should be substantial.

Results on all types of dyeing equipment are said to be brilliant in shade, a significant value as acrylics eye the fashion markets for added sales.

Since the new dyes are said to color to the core of the fiber, exceptionally fine build-up is reported in the heavier tones, to colors of great richness and bloom. The controlled fiber-dye affinity also is said to make possible an exceptional range of level pastel shades.

The Calcozine dyes reportedly can be stripped back by boiling in a bath containing common salt, providing the dyer with greater control and flexibility. Fastness characteristics and resistance to spotting are also termed excellent.

The new dyes are said to be applicable to such fibers as Orlon 42, Acrilan 16 and Verel by salt and acetic acid dyeing procedure. Creslan 58, Dacron 64 and Acrilan 3400 can also be dyed with maximum effectiveness, with suitable dyeing assistants or pretreatment, it is claimed.



Microphotographs show core-dyeing power of Cyanamid's new line of Calcozine acrylic dyes. Acrylic fibers on the left are said to have been dyed with Calcozine Acrylic Red 3G without resort to a retarder, while those on the right are said to have been colored with a product that has been considered one of the better dyes for acrylics, and which requires the use of retarding agents. In both cases, it is claimed, the manufacturers' recommended dyeing procedures were followed on Orlon acrylic fiber.

Extensive use in blends is anticipated, since the new compounds reportedly show little tendency to stain cellulosic or animal fibers. Cross-dye and union effects are said to be more easly controlled.

Cyanamid, which has a long-term interest in acrylics, predicts that the Calcozine line will help make the successful dyeing of acrylic and modacrylic fibers an economically routine and dependable process.

Cyanamid was the first in the United States to manufacture acrylonitrile, the basic raw material of all acrylics, and is producing its own Creslan acrylic fiber. Development of the new coloring compounds could mark a significant advance in acceptance of these fibers.

Athough demand for acrylics is reported likely to approach the 160-million-pound-per-year mark by the end of 1960—second only to nylon among noncellulosic fibers—only 70% of the current available capacity will be necessary to satisfy the need.

M H Mettee, sales manager of Cyanamid's Dyes Department has stated that new outlets are required if acrylic fiber demand is to grow and capacity is to be profitably used.

Estimates made prior to the introduction of the new Cyanamid dyes placed the potential increase in acrylics demand at 20 million pounds per year over the next five years, with a consumption of some 250 million pounds, or a quarter of the market for noncellulosic fibers, in 1965.

In 1955, five years after they first became commercially available, acrylics held 16% of this market; in 1959, the figure had risen to 22½%, with a further percentage increase forecast for 1960.

"The increase will depend on the development of new markets, and the capturing of larger portions of old ones," Mr Mettee said. "Sweaters, already important, will probably become increasingly so in the future. Carpets are growing, along with other home furnishings and blankets. Other ready-to-wear, particularly in blends with other fibers, are the coming thing, along with knit pile fabrics and even undergarments and lingerie."

Leucophor A; Ceranine PN

Two new chemical specialties for use in textile finishing are offered by Sandoz, Inc's Chemical Division. The first of these products, Ceranine PN, is a cationic softener for polyacrylonitrile fibers. The second of the new products is Leucophor A, an improved, acid-stable fluorescent whitener for cellulosic fibers.

The softener, Ceranine PN, reportedly may be applied to polyacrylic fiber products at any stage in their production. It is said to give a soft, lofty, cashmere-like hand, something particularly desired in the marketing of high-bulk acrylic yarns and knit goods. Other claims for the new softening agent include improvements in the winding, weaving, and knitting properties of yarns, as well as in sewing properties. The softener also is said to act as an antistatic agent on synthetic fibers in general.

The optical whitener, Leucophor A, resembles earlier optical whiteners in that it acts to increase the amount of light reflected to the eye, due to a change of the invisible light rays to the visible wavelengths of the spectrum. Its special advantages are said to be technical, since it is designed for application in acid finishing baths, where old-style whiteners reportedly have proved much less efficient. Leucophor A optical whitener, according to Sandoz, surpasses previously available brighteners in yield when used in synthetic-resin finishing baths with acid catalysts.

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National Lanamid Violet 2BL

The addition of National Lanamid Violet 2BL to its line of neutral-dyeing premetallized dyes has been announced by Allied Chemical's National Aniline Division.

National Lanamid Violet 2BL is approximately equal in strength, but appreciably bluer than Lanamid Violet RL on both wool and nylon. Its fastness to light and washing and suitability for tippy wool are practically the same as for Lanamid Violet RL. Also, it is said to possess good solubility and to be suitable for low temperature dyeing, and for dyeing nylon and wool union.

With the growing popularity of grape wine and helio shades, it is suggested that National Lanamid 2BL will be of considerable interest to woolen and worsted mills.

National Lanamid 2BL is priced at $4.83 per pound in barrels. Samples are available upon request by writing National Aniline Division, 40 Rector Street, New York, NY, or a branch office.

Nopcotex NP-25

Nopco Chemical Co, 60 Park Pl, Newark, NJ, has announced production of a new nonionic softener and napping aid, Nopcotex NP-25. The product is recommended by Nopco for use on cotton and synthetic fabrics. As a pure finish it is said to have excellent resistance to yellowing. It also functions as a lubricant, aiding in the cutting and sewing operations.

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Palo-Stat PM; Palo-Fix

De Paul Chemical Co, 44-27 Purvis St, Long Island City, NY, has announced the development of Palo-Stat PM, an antistatic agent, and Palo-Fix, a fixing agent for direct dyes.

Palo-Stat PM reportedly will withstand many launderings and is said to be only slightly affected by drycleaning. While De Paul does not claim that the product is a permanent finish, it does claim that its tests show the product to have "more permanency than others on the market today".

Palo-Stat PM has a pronounced affinity for all the new synthetic fibers and can be almost completely exhausted in the rinse bath, it is claimed. It may be employed in enclosed machines or open vats and jigs. It is recommended by De Paul for yarn dyeing, upholstered goods, tricot, sweater dyeing, etc. It is stated that the product has no effect on lightfastness and will not cause any shade change.

De Paul stresses that the bath be kept at a pH of 4.5 to 5 when Palo-Stat PM is used.

Palo-Fix reportedly has been tested with over 400 direct dyestuffs, representing virtually the entire line, and in all cases has shown little or no effect on lightfastness or shade change, a reputed advantage over the copper-salts type.

Palo-Fix, a cationic product, is said to be very effective in the aftertreatment of direct dyes on all fibers, and it is said to be useful in union dyeing to improve wetfastness of the direct-dyed synthetic fibers in blends and mixtures. In printing with directs, Palo-Fix may be used in the afterwashing process to prevent bleeding. De Paul recommends that it be used where white discharges are desired.

It is claimed that Palo-Fix has no effect on the hand of treated goods, and goods dyed or printed with vat or sulfur dyes and treated with reducing agents can be improved by an afterrinse with the product.

Palo-Fix may be applied in jigs, dye becks or padders. De Paul stresses the importance of applying the product in a cold bath with the addition of acetic acid to bring the pH to 4.5 to 5, slowly raising the temperature to 90 to 100°F, and then running for 10 to 20 minutes.

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Dowfax 9N9

Availability of commercial quantities of a nonyl phenolethylene oxide nonionic surfactant under the name Dowfax 9N9 has been announced by Dow Chemical Co. The product as offered contains 9-10 moles of ethylene oxide and has a cloud point of 52-56°C.

Literature and samples are available from Dow's Technical Service and Development Department, Midland, Mich, or Dow sales offices.

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Algepon #230, #281

Arkansas Co, Inc, Newark, NJ, has added two new dyeing assistants to its group of dyeing auxiliaries with the introduction of Algepon #230 and Algepon #281.

Algepon #230 is a retarding agent for dyeing 100% Orlon using cationic dyes. It is said to produce exceptionally uniform and level dyeings, due to its continuous retarding effect throughout the dyeing cycle, and to be particularly applicable for dyeing light and pastel shades.

For optimum results, Arkansas Co recommends a prescouring operation with a nonionic detergent, such as Dergon O M, followed by rinsing.

Algepon #230 is described as a liquid cationic product, readily soluble in water, acid in reaction, with a pH from 5.0 to 5.5.

Algepon #281, a dyebath assistant, is said to be highly effective in eliminating barré marks when dyeing nylon with selected acid dyes.

Used in accordance with the procedure recommended by Arkansas, it reportedly does not affect adversely the lightfastness of the fabric.

Algepon #281 is said to be easy to use and also economical, requiring only 4% on the weight of the goods for best results. It is described as a liquid easily dispersed in water, and completely stable during the dyeing operation. A modified cationic compound, it has a slight acid reaction, with a pH range of 5.0 to 5.5.

Samples and further information in both products are available from Arkansas Co on request.

Punch-Press "NAEF" Model B

NAEF Sample Cutting Press

The NAEF Model B punch-press is designed for easy manual operation in the cutting of soft materials such as textiles, paper, leather, plastic, etc.

Thin materials such as textile may be cut up to 40 plies, product and waste material are knocked out with each release of the press arm, and dies are said to be rapidly interchangeable.

Dimensions of the machine are 23″ high, 15″ wide, and 16″ deep. Weight is 85 lbs.

For further information, write SMS Instrument Co, PO Box 24, Rensselaer, NY.

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Asco Pirani-type Gauge

The Asco Pirani-type gauge manufactured by Arthur F Smith, Inc, 311 Alexander St, Rochester 4, NY, is said to meet today's demanding requirements for long, trouble-free service and high-level performance.

Wide range, fine calibrations and easy reading are said to be attained with its wide scale, illuminated meter movement and dual reading scale (.1 microns Hg to 5000 microns Hg). It self-calibrating.

A new transistorized circuit is claimed to afford long, trouble-free use and Zener diode stabilization reportedly helps insure accuracy to better than .1%. The gauge is said to be shock resistant to 8 g's and is made of strong polyester, shock-proof case and mount. 115 Volt, 50-60 cycle operation. Price: $149.00.

Asco now offers a recorder in two ranges, from 0 to 25 microns and 0 to 5000 microns. Designed for use with the Pirani-type gauge, it is claimed to be the smallest and simplest strip chart recorder on the market, and to provide true rectilinear recording free from inconvenient distortion.

Operating at one inch per hour, a 63-foot chart roll records for 31 days. A galvonometer pointer swings free, being clamped for marking briefly once every two seconds, generating a continuous line of many small dots.

The marking process is entirely dry, utilizes pressure-sensitive paper, and reportedly requires no ink, typewriter ribbon, electric current or heated stylus. A positive synchronous motor drive with sprocket engages holes in chart paper for accurate indication. Gear trains are available for various speeds. Rated accuracy is said to be 2% of full scale. Available for portable use or with brackets for panel mounting.

Dimensions: 3⅝″ wide × 5⅝″ high × 4⅛″ deep. Weight with paper roll —3½ pounds. Price: $193.00.

The Asco controller is designed to operate with the Asco Recorder and the Asco Pirani-type gauge. Electromechanically controlled, the controller uses contact meter-relays as its principal component. The meter-relay indicates the control variable, and it initiates control action.

Meter contacts reportedly pass only small amounts of DC and are self-locking, so the Asco Controller has a power supply to furnish DC for the meter contacts and a DC slave relay into which these contacts work.

In applications where a variable is held to a present level, an interrupter is used to separate the meter-relay's locking contacts periodically. This allows the meter-relay to sample to see if further control action is necessary.

Meter-relay indicating accuracy—DC is said to be 2% of full scale and make-break (control) differential, less than 1% of full scale. Available for portable use or panel mounting.

Control range: .1 to 5000mm Hg. Dimensions: 5 5/16″ wide × 5¾″ high × 10″ deep. Price: $194.00.

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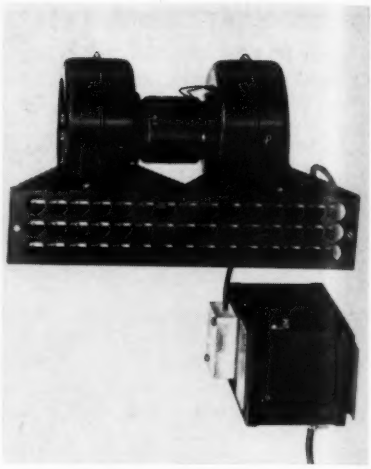
Simco Aerostat Blower-Ionizer

The Simco Co, 920 Walnut St, Lansddale, Pa, has introduced a long-range static eliminator, called the Aerostat. This new device incorporates a static neutralizer-head in the air outlet of a centrifugal blower and is claimed to neutralize static at distances of up to four feet on materials passing through the air stream. The ionization which causes the static elimination is produced in the static neutralizer head and is carried over these distances in the air from the blower.



Double-unit Aerostat

The Aerostat is available in two sizes, the smaller having an effective length of 10″ and the larger double unit (shown in the photo) having an effective length of 20″. For discharging large parts or wide materials, the units may be butted together to create a continuous neutralizing field of any width extending out from ionizers to a depth of field of four feet.

Both sizes of Aerostat are available with standard static neutralizer-heads (Types A-10 and A-20) or with "shockless" static neutralizer-heads (Types AS-10 and AS-20).

A small power pack will operate a number of the devices.

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Scotchgard Applied to Rainwear

Application to rainwear is the latest application of Scotchgard, Minnesota Mining & Mfg Co's textile chemical which was introduced several years ago.

It is reported that Cone Mills, Dan River and Pepperell are making Scotchgard-treated rainwear immediately available.

The St Paul firm claims that the textile treatment does not change the hand, texture or color of the fabric to which it is applied. Rainwear applications reportedly will be on all fabrics constructed or designed for the rainwear trade including cotton and Dacron-cotton blend fabrics.

The fluorochemical is said to offer the rainwear industry a unique combination of properties: durable water repellency through repeated washing or standard drycleaning; the ability to repel oil-borne and water-borne stains; resistance to soiling and a finish that dries fast.

• NAMES IN THE NEWS •

Schubert

Emery

A W Schubert on June 24 was elected president of Emery Industries, Inc, succeeding *John J Emery*, who has taken over the newly created post of chairman of the board. Mr Schubert formerly was executive vice president.

Emery's most recent expansion was disclosed in June. The Cincinnati chemical company announced formation of a European company owned jointly with Unilever, N V, of Holland. This new company, Unilever-Emery, N V, has headquarters at Gouda, Holland, where construction of a plant is under way.

Stockholders elected *William S Rowe*, to the board of directors. He succeeds his father, *John J Rowe*, who served on the Emery board for many years.

Re-elected as directors of Emery were: *William H Chatfield, H Wm Gudmens*, and *Thomas Hogan Jr.*

The following officers were re-elected: *K K Boyd* and *Rober Van Tuyle*, vice presidents; *H W Altvater*, treasurer; *L D Myers*, secretary; *J A Mueller*, assistant treasurer; and *H B Menke*, assistant secretary.

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Ronald Sundberg has been appointed a sales representative for the Chemical Division of General Mills.

In his new position, Mr Sundberg will headquarter at the division's Kankakee, Ill, general office. He will be responsible for sales of General Mills Versamid polyamide resins, GenEpoxy epoxy resins, Genamid liquid co-reactants, fatty nitrogen chemicals and other organic chemical specialty products in Indiana and Michigan.

Mr Sundberg was associated with Procter and Gamble and American Mineral Spirits Co in sales prior to joining General Mills.

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Heinrich Habig Jr, technical manager, Heinrich Habig AG, has been named to the board of directors of the Herdecke-Ruhr, Germany, textile printing firm.

Dodd

Klomparens

Edward M Dodd has been elected a vice president, and *Karl Klomparens*, industrial sales manager, at Diamond Crystal Salt Co.

Mr Dodd, assistant to the president, joined Diamond Alkali in April, 1957, after its acquisition of Jefferson Island Salt Co, where he was vice president in charge of production.

Mr Klomparens had been technical director since joining the company in 1955.

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Killinger

Kesler

Foster

Three new vice presidents have been appointed to the Corn Refining Division of Penick & Ford, Ltd, Inc. They are *J E Killinger*, vice president of technical sales service and field development; *C C Kesler*, vice president of research and development; and *S H Foster*, vice president of production.

Dr Killinger joined Penick & Ford in 1929 and later founded the Sales Service Department.

Dr Kesler has been associated with the company since 1926.

Mr Foster joined Penick & Ford in 1933 and has been manager of the Cedar Rapids Plant since 1955.

Schulz

Lawrence

Ciba Co, Inc's Chemical Specialties Division has announced the promotion of *Werner F Schulz* to the West Coast territory.

Since early 1958, Mr Schulz has represented Ciba in a special sales-service capacity in the New York-New Jersey metropolitan area, the New England states and the South. He is a member of the AATCC and is national vice chairman of the Individual Membership Committee.

In line with expanding its recently formed Pigments Division, Ciba has announced the appointment of *William Lawrence* as supervisor of the division's Technical Service Laboratory.

Serving in a technical capacity in the paint industry for the last twenty-five years, Lawrence was with Flood and Conklin Mfg Co prior to joining Ciba.

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Paul J Cardinal has been appointed general chairman of the 70th Annual Convention of the Drug, Chemical and Allied Trades Association to be held at the Sagamore Hotel, Bolton Landing (on Lake George), NY, during the week-end of September 15th through 18th. Mr Cardinal is vice president of Hoffman-LaRoche, Inc.

William W Huisking, president of Chas L Huisking & Co, Inc, and president of the Drug, Chemical and Allied Trades Association, has named *Robert H Kampschulte*, Celanese Corp of America, chairman of the business program. *Paul Klemtner*, Paul Klemtner & Co, Inc, has been named chairman of publicity.

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Four additions to the research staff have been announced by Fabric Research Laboratories, Inc, Dedham, Mass.

Named to intermediate reesarch associate positions are *G A M Butterworth, Rohit M Desai*, and *C Rchard Desper. Elizabeth Cilley* has been appointed a research associate.

Vergara

Goeldlin

Brooks

KixMiller

Gilwood

Calmon

Conze

Orr

Taylor

Worth

Edmund Vergara, who was formerly with the Treasury Division of American Cyanamid Co, has been appointed credit manager for the Dyestuff, Chemical and Pigment Divisions of Sandoz, Inc. Successor to *Harry R F Goeldlin,* retired at 65 under the company's pension plan, Mr Vergara is a member of the New York Credit and Management Association, and active in its Credit Group, which specializes on problems of colorant and textile auxiliary suppliers.

Mr Goeldlin, who has terminated a career with Sandoz that began in 1933, was the 1959-60 chairman of the aforementioned Credit Group.

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Celanese Corporation of America recently announced a reorganization of certain divisional operations, along with the appointments of *John W Brooks* and *Richard W KixMiller* as new executive vice presidents and of four new division presidents.

Mr Brooks and Mr KixMiller previously both had been corporate vice presidents, with Mr Brooks in charge of the fibers division and Mr KixMiller in charge of the chemical and plastics divisions.

Under the reorganization, the number of operating divisions have been increased from three to four and various functions are realigned among them. To the existing Celanese Fibers Company and Celanese Chemical Company are added Celanese Plastic Products Company and Celanese Polychem Company. The latter two new divisions supersede the former plastics division.

Mr Brooks has been assigned directional responsibility over the Fibers and Plastic Products companies, and Mr KixMiller over the Chemical and Polychem companies.

Newly appointed operating heads of the four divisions are *James H Worth,* president of Celanese Chemical Co; *Peter H Conze,* president of Celanese Fiber Co; *William P Orr,* president of Celanese Polychem Co; and *David Taylor,* president of Celanese Plastic Products Co.

Previous posts held by these men are as follows: Mr Worth, vice president, Celanese Chemical Co; Mr Conze, vice president and director of marketing, Fibers Company; Mr Orr, vice president, Plastics Company; Mr Taylor, vice president and manager of manufacturing, Fibers Company.

The new organization represents a more logical alignment of Celanese products from marketing and manufacturing standpoints. The Chemical and Polychem companies are producers of basic chemicals and polymers, while the Fibers and Plastic Products companies are concerned essentially with converted polymer products, which are nearer to the finished end product and consumer in the chain of distribution.

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Robert E Ward has been appointed plant manager of The Carwin Company's North Haven, Conn, plant.

Mr Ward was previously a production supervisor for General Aniline & Film Corp in Linden, NJ.

Specialty isocyanates, high-temperature polyurethane foam systems and organic chemicals are produced at Carwin's North Haven plant.

The Permutit Company, New York, NY, has inaugurated a new research and development program to explore and pursue all promising areas for future growth. An intensive effort reportedly will be made to develop appropriate new chemicals, processes and equipment. Although emphasis will be in the water-treatment field, expansion will not be limited exclusively to this phase of industry. The Permutit Company is a division of Pfaudler Permutit, Inc.

In order to implement the program, *M E Gilwood* has been appointed director of development to head up a technical team which will devote full time to these objectives. *C Calmon,* director of laboratories at Permutit's Birmingham, NJ, chemical plant, has been named director of research, the post formerly held by Mr Gilwood. He will also continue to supervise the chemical laboratories. *A B Mindler* and *A W Kingsbury* have been appointed associate directors to assist Dr Calmon.

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The National Safety Council has named *Robert G Belknap* staff representative for its rubber and textile sections.

Mr Belknap was with Bemis Bros Bag Co for 11 years before going with the Council. From 1949-52 he headed the employe suggestion and safety programs for the entire company, and for the last eight years was personnel manager of the paper bag plant in East Pepperell, Mass.

Mr Belknap will be liaison man between the Council staff and officers of the rubber and textile sections. He also will be technical advisor to Council member firms in the rubber and textile fields.

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William G Sumner has been promoted to the position of sales engineer at the Chattanooga, Tenn, branch office of the Dyestuff and Chemical Division, General Aniline & Film Corp.

Mr Sumner has been associated with GAF in the Dyestuff and Chemical Division since 1953. He served as a group leader in the textile section of Antara Chemicals Division's

Technical Department from 1953 to 1958. More recently he has held a similar post at the company's Central Research Laboratories in Easton, Pa.

Four new appointments affect the research organization of GAF's Dyestuff and Chemical Division.

R L Mayhew, formerly program manager in charge of chemical specialties since 1955, has been advanced to the newly created position of technical coordinator—acetylene derivatives, surfactants and chemical specialties. He will headquarter at New York and report to *Melvin R Stevenson*, director of research, and assist him and individual laboratory managers in the planning and coordination of major research and developmental projects, and programs of interest to the Division in the general area of organic chemicals, including commercial development, manufacturing and marketing interests.

J L Azorlosa, since 1955 assistant program manager of the Division's applications research and technical service organization with special responsibilities for the acetylene chemicals area, has been promoted to the newly created position of program manager—exploratory polymer research, at the Central Research Laboratories, Easton, Pa.

M E Chiddix, program manager—acetylene derivatives research, will also serve as program manager—chemical specialties research at the Central Research Laboratories. He will handle Dr Mayhew's previous activities, with the exception of the exploratory polymer phase, which has been incorporated into Dr Azorlosa's function.

S A Glickman, who has worked with GAF in the field of acetylene derivatives since 1947, has been appointed assistant program manager—acetylene derivatives research. He will report to Dr Chiddix.

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An oil portrait—a tribute of Chemical division personnel of The Goodyear Tire & Rubber Co—was presented to Herman R Thies, general manager of the division, to commemorate completion of his 30th year of service with the Company. He has headed the Chemical division since it was formed in 1948, guiding it to a position of prominence in the chemical industry. Presentation was made by C O McNeer, division general sales manager, during a testimonial dinner honoring Thies.

In anticipation of the opening of its new Monroeville Laboratory Center and continuation of the Verona Center for chemical engineering and other activities, Koppers Co, Inc has announced additions to and changes in the Research Department staff.

E W Volkmann becomes manager of the Monroeville Center and *F L Jones* will be manager at the Verona Center. *W Conrad Fernelius*, former head of the Chemistry Department at Pennsylvania State Univ, joins Koppers as associate director of research. *E M Fettes*, until recently director of research and development for the Chemical Division of Thiokol Chemical Corp, joins Koppers as manager, Plastics Section, Research Department.

E E Donath has been named manager of Contract Research; *C F Winans* was appointed European representative with headquarters at Zurich; and *R B Spooner* becomes manager of associated researches.

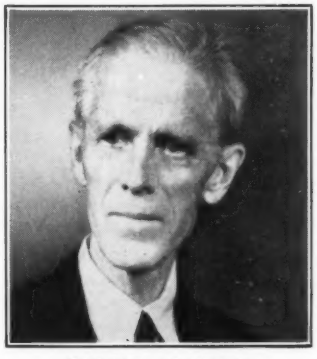
Previous positions of five of the aforementioned were with Koppers as follows: Dr Volkmann, manager of the Verona Research Center; Dr Jones, manager, Associated Researches Section at the Verona Center; Dr Donath, manager of the Technical Planning Section; Dr Winans, administrative assistant to the director of research; and Dr Spooner, manager of the Physics Laboratory at the Verona Center.

HAROLD M CHASE, 88, distinguished research chemist and recipient of the 1948 Olney Award, the first Southerner to receive this distinction, died July 6 after a decline in health following a fall about a month earlier. He had been connected with the Dan River Mills for 43 years, having been appointed chemist and assistant superintendent of dyeing in April, 1917.

Mr Chase was born in Dracut, Mass, in 1872. Educated in the local schools, he matriculated at Massachusetts Institute of Technology in 1888 from which he received a BS degree in chemical engineering and a postgraduate BS degree in chemistry.

His first position was that of overseer of a small dye house in Wilmington, NC, and it was here he obtained his first experience in textiles and dyeing processes. In the period between 1907 and 1917, he engaged in a wide variety of experimental work ranging from raw stock dyeing and the mercerizing of yarns to an invention for regaining turpentine from stumps and lumber waste of the long leaf pine.

Two years after joining Dan River,



HAROLD M CHASE

he became chief chemist and superintendent of dyeing, and it was at this time that he was responsible for the design and supervision of what was reportedly the world's largest raw stock dyehouse, with a capacity of more than 750,000 pounds of cotton per week. He also introduced the idea of forcing hot air in the dyehouse to dispel the fog, and his system of forced ventilation proved to be the first practical method of combatting fog, and served as the pattern for present-day ventilation projects.

In 1937, he became director of research and proceeded with the development and patenting of a long-chain continuous indigo dyeing process. He was also associated with the development of the vat pigment continuous dyeing process and the perfection of the fiber-bonded process invented and patented by H Y Jennings. This latter process was probably the first of its kind to engage the chemical as well as the mechanical properties of fibers, and it was from this stepping-stone that Mr Chase went on to develop the Wrinkl-Shed treatment.

He retired in January, 1949, but was retained as consultant in dyeing and finishing until his death.

Mr Chase was a charter member of AATCC.

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ERNEST J ZILLESSEN, 69, died July 5 at Barnert Memorial Hospital, Paterson, NJ, after a short illness.

Mr Zillessen, a member of AATCC, was president of Silk City Chemical Corp, Paterson, NJ, until his retirement a year ago.

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WANTED: DISTRIBUTORS with contacts to handle textile and chemical specialties of a New Jersey manufacturer. Give experience and details. Write Box No. 936

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WANTED: DYESTUFF SALESMAN for North Georgia and Tennessee territory by established dyestuff company offering a complete line of colors. Dyestuff experience required; selling experience preferred. Write Box No. 946

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POSITION WANTED: LABORATORY CHEMIST OR SALES. B.S. in Chemistry—24 years old—single—2 years plant laboratory experience with all classes of dyestuffs on natural and synthetic fibers. Will relocate—Piedmont Carolinas preferred. Write Box No. 945

POSITION WANTED: SALESMAN—Available for New Jersey, Northern Pennsylvania, New York areas. Vats, Pigments and Finishing experience. Resume on request. Write Box No. 949